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BRIEFLY TOLD.

WILL GOVERNOR-ELECT BRACKETT REFUSE TO REAPPOINT COMMISSIONER ROWELL?—One result of the recent election in the State of Massachusetts was the indorsement by the voters of the candidacy of Mr. Brackett for the Governorship. It is also worthy of notice in this connection that Mr. Brackett (who headed the Republican State ticket) received a plurality of about 6,000, whereas the head of the same ticket in 1887 (Mr. Ames) had something like 18,000 plurality—and 1887 was not a particularly good year, either, for the Republican party of Massachusetts. Of course, these figures are merely given to show that Mr. Brackett did not by any means command the full confidence of his party, and the real matter of interest about it is why should there be such defection from the standard bearer of a party that without doubt largely and surely controls the politics of the State. It is very likely that such defection could be traced to many causes, having their seat in what is known as practical politics, but with these we are not concerned. Not so, however, do we feel respecting certain echoes connected with the late election that are now going the rounds of the Massachusetts daily press. From these we learn that Governor Brackett proposes, among other things, when he shall have assumed the duties of his high office, to "see to it that Edward Thomas Rowell is not a member of the Gas Commission next year." We hope that the public prints have made this prophecy out of whole cloth, and that the Governor-elect will not, out of political resentment, strike a bad blow at a Commission whose membership and course have won the admiration of the gas makers of the United States. The Gas Commission of Massachusetts is no longer an experiment, likely to lead to doubtful results, in the minds of the gas making fraternity, and even those of the latter who at the outset were opposed to such commissions have been all but won over to the utility of such bodies, simply from observing the practical benefits arising from the operation of the Massachusetts example. In this light we consider that Governor Brackett would committ a grievous error did he refuse to reappoint Mr. Rowell, for the latter's record on the Commission has been that of a careful, painstaking, conscientious and competent public servant. Should he fail of reappointment, the position taken some time ago by gas men who objected to State Gas Commissions, on the ground that politics and not capability would be apt to figure as the most potent factor in the selection of the Commissioners, would look more tenable than it has seemed in the past. As there is no question as to Mr. Rowell's fitness for the place that he holds, justice, as well as the preservation of the Commission from the smirching of "practical politics," will be served by his reappointment.

THE BRITISH GAS INSTITUTE'S TRANSACTIONS, 1889.—We are indebted to Mr. Wm. Longworth, Honorary Secretary of the Gas Institute, for a copy of the "Transactions" for the current year, and congratulate him upon the promptness with which the volume has been issued. This promptness is all the more noteworthy and commendable because it was the Secretary's "first experience" in this direction; but it is also true that he had the benefit of ex-Secretary Bennett's efforts to guide him. If imitation is the sincerest form of flattery, then that unction can be applied to himself liberally by the ex-Secretary; for the Longworth volume, in typography and make-up, closely resembles the style inaugurated by Mr. Bennett. The current volume is much smaller—as to contents or bulk—than many that have preceded it, but that is traceable to the comparatively few papers read at the 26th annual meeting. Nor was that paucity unexpected, since it was rightfully presumed that much of the time of the meeting would be taken up in disentangling the snarl into which the affairs of the Institute had been plunged through internal dissensions. The volume, however, contains much that is valuable, notably, perhaps, the communication by Mr. Valon, of Ramsgate, whose success with the use of oxygen as an adjunct to gas purification was so graphically related to the American Association at its Baltimore meeting by Mr. E. B. Ellice-Clark. Those of our readers who wish to procure a copy of the Transactions can do so by ordering the same through us.

FUEL AND ITS APPLICATIONS.—Some time since Messrs. P. Blakiston, Son & Company, of Philadelphia, arranged for the reproduction in this country of a new edition of "Chemical Technology," based on the lines of what is generally known as "Knapp's Technology." The first volume of the series, entitled "Fuel and Its Applications," is now in the hands of the booksellers, and its value is such that it is meeting with a

ready sale. The book was edited by D. J. Mills, F.R.S., and F. J. Rowan, C.E., among whose assistants was Mr. F. P. Dewey, of the Smithsonian Institute. Even a hasty glance through the volume before us compels the verdict that the editors and compilers have most satisfactorily carried out their purposes, and we have no hesitation in advising the gas men to purchase the book. It contains no less than seven handsome plates, and 607 separate illustrations; the letter-press and engravings, with index (which is most copious), take up 802 pages, and within that compass the story of "Fuel and Its Applications" is amply and well told. Space forbids any lengthy review of the volume, but we can say that its pages teem with information for the gas maker.

MR. WESTINGHOUSE IS NOW CLOSER TO A SOLUTION OF THE PROBLEM THAN BEFORE.—George Westinghouse, Jr., of Pittsburgh, is beyond doubt a remarkable man, and can be always counted on to give freely of his time, energy and money for the development of any project that has enlisted his attention. While other "enthusiasts" were shrieking loudly over what was wanted, and were very glib in their invitations to capitalists to lead them into the promised land of fuel gas, Mr. Westinghouse quietly went ahead, through the agency of the Fuel Gas and Electric Engineering Company, in a practical way to devise methods of manufacturing and distributing a fuel gas that should find favor with the people because of its value and cheapness. No stint of apparatus or capital interfered with the operations of the Company's engineers, and the latter were finally forced to the conclusion that the solution of the problem—at least in the near future—was not for them. The experiments were accordingly discontinued, but not until something over two years had been absorbed by them. Now, Mr. Westinghouse is also given to saying just what he believes, and to speaking so that those in his vicinity can hear him quite distinctly. Hence, when the New York *Sun* a few weeks ago gave editorial utterance to the fact that Mr. Westinghouse had made valuable discoveries in the fuel gas field, that gentleman promptly forwarded the *Sun* a communication in which he made clear to our minds that he had at last solved the problem. The pith of the Westinghouse letter is this: "A Company with which I am connected has devoted about three years to the heating gas problem. The investigations have been carried sufficiently far to show that a new process for the manufacture of gas is not needed to bring its use for heating purposes within the reach of many." He follows this up by remarking that the proper way to obtain success is "in the development of appliances for burning gas economically."

MR. HENRY K. SHELDON has been elected President of the Brooklyn Gas Light Company, vice Col. J. H. Armington, resigned.

Heating by Gas.

The Boston *Advertiser* says that to the people in the New England States the luxury of heating by gas is something unknown. In the former days those in the East used to congratulate themselves upon living in its civilization and amongst its comforts. We then considered Illinois and the States adjoining, West. To-day by the help of natural gas they are in the household more comfortable than we of the New England States. This is true not only of the cities, but it is true of the small towns and even of the farms along the pipe lines of the many gas companies. It was a common practice to exchange gas for rights of way for pipe lines.

The writer never realized the beauty of natural gas until visiting a friend in Western Pennsylvania during the winter, he was impressed with the ease and convenience of using natural gas for heating and cooking and to a less advantageous extent—lighting. It was very agreeable to sleep in a cool, well-ventilated bed-room and yet in the morning shiver but a full minute while closing the window, throwing in the fireplace a lighted match, and turning on the gas to a full blaze, comfortably take the second nap that every one finds so delightful on winter mornings. The bedroom was quickly heated, and dressing (in this country town it will be remembered) was comfortably proceeded with. This comfort did not involve some one's discomfort in rising at four or five in the morning to get the furnace at work, and get up the heat for the day. The material used as a baffler for the gas and storer of heat was the refuse from a neighboring tumbler works.

And just here let me say a word for such people as may visit the natural gas country; whenever you wish to light a fire, place the match or burning paper in the grate, stove or what not and then, and not until then, turn on the gas. The reason for this is that natural gas is furnished the consumer at a pressure so much above what we are accustomed to in the usual illuminating gas, that before one realizes it the quantity of gas issuing from the burners is enough to form a large volume of explosive compound with the atmospheric air before the light can be applied. It is from neglect of this common sense precaution that such frightful explosions and consequent loss of life have occurred. In the city of Buffalo natural gas is served through a meter at a fixed price per thousand cubic feet and at a pressure of several ounces. At this price, with the best anthracite coal at $5 a ton, householders can use the gas for cooking and heating in ranges, stove and furnaces, and at less cost than the price of the coal fuel alone, not considering the labor of carrying in coal, danger from fire and labor of carrying out ashes, with the dirt and injury attending this operation, besides the trouble, worry and annoyances only realized by the man who must look after the furnace fire and the woman the range. We all know that the first thing the servant stipulates is that she will not tend the furnace.

From what has been said, any one who has had the experience with the methods of heating in New England, and the methods in Ohio, eastern New York, Pennsylvania and Illinois, would infinitely rather live in the latter places if there were not other disadvantages. How welcome, then, a similar system in the East. It should be noted that in furnaces using natural gas there is usually a graduated burner or burners—the eighth part of any number of eights to the whole can be turned on, depending upon the severity of the weather and the heat required; it is thus that economy can be consulted.

Is it any wonder then that so many people are to day hoping and thinking and experimenting upon devices to bring this about in the East? Already a fuel gas process is in use that has saved large and prosperous manufacturing establishments from closing their doors in the East and going to the natural gas fields; the use of artificial gas is all that saved them. If this is true of manufacturing, why should we not enjoy this in our households? We will some day and at no very distant day it is justly hoped and with reason. That there is a demand for this is indorsed by the large number of gas stoves of various styles made to-day. In our own city of Boston there are a large number of shops where gas stoves can be purchased, not only for cooking but for heating. For cooking there is no longer question that this not only can, but is carried on with profit to those who have tried it. It is of great advantage to be able to have the heat when needed and save it when not desired—especially is this latter desirable. Contrary to popular belief, no good gas cooking stove will give any unnatural odor or taste to the food, and there is a positive saving in weight of meats, etc., after cooking, as over coal. If one goes into many an office in Boston he may see illuminating gas being burned either in gas logs or with artificial coal (which is artificially prepared lumps of an indestructible compound, that when heated to a gentle red looks strikingly like an anthracite coal fire), or in the reflector stove. If any one has an interest in this matter let him drop into the writing room next to the gentlemen's cafe of the Adams House, and he will see gas burning there in the long grate which is filled with artificial coal. It is artistic in the extreme, and the freedom from dirt and care outside of any other consideration must have been a boon. Such fires in your library and parlor, surrounded by the artistic effects of the fireplace above instanced, would give you as much comfort and as much cheerfulness as an anthracite fire, and without the labor of firing and the consequent dirt that ruins fabrics, hangings, carpets and rugs.

Quite enough dust comes from Boston's macadam streets without adding to it in every fireplace. This appeals to the many families that live in apartments and flats in Boston. The storage room is limited, the quantity of coal to be bought is small and must be bought, therefore, at the highest prices. The use of gas in heating, therefore, is of special interest to such houses. The writer will not attempt to give a detailed description of stoves and of the many styles. The observant citizen will see the advertisements and the display in the shops. That there is abundant heat in illuminating gas we all know from experience in a confined atmosphere.

Gas stoves are made that by carrying in a cool air supply from the outer air and carrying off the products of combustion to a chimney flue, the heat is utilized and the waste of oxygen is made up and more than made up by the heated fresh air from out of doors. So the purchaser has the choice of gas logs, the grate with artificial coal, the copper reflector style of stove, with or without fresh air attachment above described, or method of water heated stoves. This latter system permits of obtaining hot water for household use and for such purposes as may be desired, as in the cooking stove attachments. We all know that hotels use gas stoves, laundries use it for irons of all kinds, hat manufacturers, plumbers, canners, bottlers, confectioners use it, and it is used for other manufacturing uses that would only tire the reader with enumeration. For those who desire figures, regular gas cooking stoves consume from 18 feet to 60 feet per hour, or in Boston gas, 2¼ cents to 7.8 cents per hour, and for hotel use, 75 to 100 feet per hour, or 9.75 cents to 13 cents per hour. Broilers and boilers burn as low as 5 feet, or in Boston gas, .65 cents per hour. The reflector fires burn from 12 to 20 feet, or in Boston gas, 1.56 cents to 2.60 cents per hour; asbestos gas fires, 20 to 25 feet, or 2.6 cents to 3 26 cents.

It is thus evident that under the circumstances mentioned it is cheaper and better to burn gas than use coal, and that the people should turn their mind in this direction to a greater extent than in the past. We all look forward to the day when the ash man and the coal man, and the dirt and trouble that go with them are in the past, and science has given us the comfort of a well-regulated gas supply, with the ease of manipulation, and at the same time the simplicity of the ordinary burner and its regulating stopcock. We will all welcome it, and at least when we once realize the advantages we would never go back to the old system—which is that of the present crude methods.

Inclined Gas Retorts.

The London *Journal*, in commenting on the studies of engineers in the direction of inclined gas retorts, remarks now, that attention has been so powerfully directed towards the working of the inclined retort system of M. Coze, it may be profitable to discuss with some detail what there is in a system of this kind to differentiate it from ordinary methods of retort setting and working and what these differences amount to in the practical work of gas making. To begin with, it must be borne in mind that there is nothing new in the idea of setting a gas retort at an angle, and introducing the charge of coal at the top and drawing out the coke from the lower end. Murdoch had an iron retort of this description in use in 1804; but in relating the story of the development of the gas retort from the primitive "pot" form to the horizontal tube finally adopted, "King's Treatise" remarks that the retorts with two openings "were necessarily more costly than those having only one opening; and they were, on the whole, found more troublesome to manage and keep in order." No other explanation is offered of the abandonment of this system of retort construction; and probably no other is available, as Murdoch, did not have any memorandum stating the reasons for the progressive alterations that we know he made in the designs of his gas making plant. With regard to the short vogue which the inclined retort seems to have enjoyed with him, it is permissible to remark that, assuming this, for the sake of argument, to be the better form of apparatus, as compared with the horizontal retort with one opening for drawing and charging, which he afterwards adhered to, this is by no means the only example in the history of the mechanical arts of a form of apparatus too good for the time when it was first introduced. The illustration of the breech-loading fire-arm may be cited as a parallel to the double-mouthed retort. It is well known that the breech-loading principle in ordnance was tried long before workmanship and material in gun-making were good enough to permit of its adoption with any surety of success. Indeed, it is the most obvious way to use a tube, whether for the continuous or intermittent reception and conveyance of material, to feed the substance in at one end and pass it out at the other; but, as we see, considerations arising out of the construction and working of apparatus modify first principles. We may be sure of one thing —that whether or not the "Treatise" account of the reason for the abandonment of the inclined retort by Murdoch is complete, he must have had good and sufficient reason for his action in this matter. We may believe, if we will, that he gave up the idea of taking advantage of the effect of gravity in charging and drawing gas retorts because inclined double-mouthed retorts are too dear and troublesome to keep tight, or we may incline to the opinion that he found some more serious objection to their use, the nature of which we may gather from later experience not quite passed out of mind.

On the other hand, it is but right to allow that coal carbonization in Murdoch's time was only carried on in the small way; and therefore the choice between taking all possible advantage of effect of gravity in dealing with retort charges, and lifting every particle of coal, laying it on the bottom of the retort, and drawing the coke by manual labor, may not have struck him as sufficiently important to warrant any great effort in overcoming the drawbacks, such as he found, of the inclined retort. However this may have been, the fact remains that when the elaboration of gas making plant passed from Murdoch's hands into those of Clegg and his immediate successors, the inclined retort dropped out of sight, and improvement was sought in far more complicated and irrational devices. Brunton's discharging retort, patented in 1835, and tried on rather a large scale at West Bromwich, is spoken of as the next practicable system of inclined retort-setting; but the description is scarcely correct, as the sole of the retorts was very little inclined—merely sufficient to give ease to the operation of pushing out coke from the front to the back, where it fell into a water-sealed pan. The chief feature of this plan was the frequent charges; and there seems to have been something in it, although evidently the advantages were outweighed by the drawbacks—probably expense of construction and restriction of the size of retorts capable of being worked in this way. All this, of course, belongs to the "iron age" of carbonization, before clay retorts had profoundly modified the conditions of the problem.

With the advent of clay retorts came the desire to increase the quantity of gas made per unit of retort-house area; and settings became multiplex. The time arrived when the reduction of the labor of charging and drawing so many retorts occupying such a limited space received much attention; and mechanical stokers, vertical retorts fed automatically, and inclined retorts fed by the hoppers, occupied the thoughts of progressive gas engineers. For many reasons the system devised by Mr. W. T. Carpenter, of Sheerness, and described by him before the British Association of Gas Managers in 1878, may be taken as the best suggestion of the second, or "clay-retort age" of gas making, before the age of gas firing came in to render practicable many things previously impossible. In Mr. Carpenter's system, the coal was made to enter the retort by means of a screw working in the mouthpiece, which received the charge continuously from a hopper, and forced it onward. The interior diameter of the retorts was greater than that of the mouthpiece; and the idea was that the coal would swell and intumesce very speedily after coming into the mouth of the retort, and that while traveling to the back it would part with nearly all its gas. The ends of the retorts were open, and overhung a chamber into which the coke was intended to fall, and be periodically taken out. Ultimately, we believe, this inclosed coke vault was dispensed with, and the back ends of the retorts left exposed, for more convenience in getting out the coke. It appears that the difficulty here was the packing of the coke towards the back end of the retort. It would not fall out or clear itself as designed; and, moreover, the consumption of fuel with such a setting must have been excessive.

The first mention of M. Andre Coze's plan of inclined retort settings was on the occasion of the meeting of the Societe Technique de l'Industrie du Gas en France at Bordeaux in 1885. Upon this occasion, M. Coze read a paper in which he maintained that the problem of the rapid and easy charging and emptying of gas retorts might be solved by having regard to the natural angle of repose of the raw material. He described his setting of retorts designed in accordance with this principle, wherein the floor of the retorts had an angle of 29° with the horizontal, at which he found the coals would rest. The charging was done by tipping a specially-designed scoop into the superior opening of the retorts, where it was turned vertically upwards, and the charge was prevented from falling down too far, so as to clog the lower mouthpiece, by means of a movable stop. The good working of these retorts was certified by M. Cornuault. In the following year, M. Coze again brought the subject under the notice of the Societe Technique, when he claimed that at the right angle of inclination, which he then stated as being 30°, any sort of coal—rough, small, or through and through, dry, or as damp as it ought to be carbonized—would stand equally well in his retorts. The perfected setting was heated by a gas generator furnace, In the discussion of M. Coze's paper, M. Ellissen remarked that the Paris Gas Company had tried inclined retorts in 1849, and cited the experience of Glasgow in 1881. All this proved, according to him, that the inclination of the retorts ought to vary from 26° to 42°, to suit the different classes of coals met with in ordinary retort house working. M. Coze contended that he had not arrived at the angle of 30° for his retorts without plenty of experiment; and that whatever might have been the causes of the earlier failures, with which he had no concern, he was in a position to prove that the one angle given was correct for every variety of coal used for gas making. He argued that several factors go to make the success of his system. In the first place, there is the angle of inclination; but this is supplemented by the form of the retort—a flattened ⏢—against the roof of which the larger lumps strike when they rebound from the shock of tipping the charge. The form and disposition of the charging scoop or wagon which tips the whole charge at once into the retort, is another factor. Thus we see that the Coze system differs from all that have been described hitherto, in being a combination of (1) generator firing with (2) flattened ⏢ retorts inclined at 30°, (3) charged periodically by a tipping-scoop, and (4) drawn by hand from the lower mouth-piece. It appears from this description that M. Coze has in fact succeeded by not attempting too much. If, like Mr. Carpenter, he had complicated his design by the addition of automatic continuous-action charging device, it is quite possible that all would have gone wrong together. As it is, the problem of success depends wholly on the spreading of the charge evenly over the floor of the retort; and this, we are informed by eye witnesses, is done in a style that the best hand-charging of horizontal retorts seldom equals; if this result can be depended upon for any length of time, whether the retorts are clean or clogged with carbon within reasonable limits, and with any variety of coal, and if the lower end of the retort is never likely to become plugged with a mass of coke when the strongly-caking North of England coals are carbonized —then there can be no manner of doubt that the Coze system has a future before it.

What the Coze system is we have endeavored to explain. What it does can scarcely be stated in full until the system has been tried on a sufficiently large scale to be compared with the work of an ordinary scoop gang in a well-organized English gas works. Here, as we are accustomed to believe, coal carbonization by manual labor has attained its greatest perfection; and with this standard, all proposed improvements must be compared. Circumstances which need not be gone into

now have arisen to make it desirable that any system of retort working which is only as good as that of scoop charging should be attentively considered, provided that it attains the desired end by means which are a change from the ordinary methods. It is not clear that the Coze system would make any noteworthy difference in the number of men required for the work of carbonization; although it is impossible to speak definitely upon this point until it has been fairly tested on a considerable scale, with the advantage of mechanically elevated coal. In any case, however, the character of the works will be different. Little training will be needed for the manipulation of the charging-scoops, which make but slight demands upon the strength or dexterity of the men who handle them; and the drawing is reduced to merely encouraging the coke to fall out of the retort by its own weight, by introducing a tool like a light "slice" between the first lumps and the retort. The work of the trained stoker is consequently greatly reduced, and should fall within the powers of any able-bodied laborer. What this means, British gas managers may be left to define according to their particular experiences.

It does not fall within our province to state precisely how much of M. Coze's design is new and original. The principle of the inclined retort is, of course, as old as the gas industry itself; but the point to be considered is that it has always failed in application before this attempt. Hence it may be supposed that M. Coze—assuming his method to prove universally successful—must have improved the arrangement in some way or other. Any gas manager in the kingdom may easily test his claim of the sufficiency of a slope of 30° for all kinds of coal, by putting up a length or two of retorts at this inclination in the yard, and tipping a barrowful of coal into the upper end, with due regard for M. Coze's precautions. This little experiment will not go very far, either to prove or disprove M. Coze's pretensions; but may lead to more important trials. The whole subject of facilitating the working of retorts is now very much to the fore; and anything that may tend to arouse and sharpen interest in the problem should receive proper attention. We have no wish to claim any more for M. Coze than is his due; and still less do we suppose that he has said the last word on the subject. Until somebody brings forward a better device, however, it is only fair to admit that the Rheims Gas Engineer occupies the field; and no apology is therefore needed for devoting special notice to the nature and prospects of his system of carbonization.

Wright's Gas Generating Apparatus.

U. S. Letters Patent (No. 414,470) were granted on the 5th inst., to Walter S. Wright, of Chicago, for claims on improvements in gas generating apparatus, the said improvements being designed for application to apparatus used for the manufacture of water gas. In further explanation the inventor says:

"The object of the invention is to provide an apparatus whereby ordinary coal and water gas may be made from the same coal, and particularly from ordinary bituminous coal. Briefly stated, the result accomplished is the distillation of bituminous coal within the apparatus and the withdrawal of the resultant gases, and the subsequent heating of the resultant coke to incandescence, and passing steam through such coke to decompose the steam and form water gas, the entire operation being performed within the same apparatus, the heat for the distillation of the coal being supplied by the burning coke. This method is adopted because of its economy.

"In the ordinary distillation of coal a certain amount of fire is needed to heat the retorts containing the coal. By the ordinary methods of distilling coal such a fire is an extra expense.

"In the manufacture of water gas by the ordinary processes considerable heat is wasted during the process of igniting the bed of coal or coke in which the steam is decomposed. By my process the water gas fire is made to heat the retorts, and the coke resulting from the distillation of the coal is added to the bed of water gas fuel without loss of heat, so that the temperature of said fuel is always high. The two kinds of gas may be led off separately for separate purifying and storage, or they may be combined and used as one gas. Either or both may also be carbureted to acquire illuminating power.

"The apparatus herein described embodies additions to the improvements described and claimed in an application for gas generating apparatus, filed by Reinhold Boeklen of even date herewith. It is also an addition to the improvements claimed in another application filed by me of even date herewith. Said Reinhold Boeklen and I have also jointly invented a modification of the apparatus shown in this and my other application and his sole application aforesaid.

"In the accompanying drawings Fig. 1 is a vertical central section in line *c c* of Fig. 2; Fig. 2 is a horizontal section in line *d d* of Fig. 1; Fig. 3 is a vertical section in line *e e* of Figs. 1 and 2.

"The apparatus consists of a general inclosure or cupola *A*, the lower portion of which, *B*, is used as a combustion chamber, while the upper portion *C* is used for the distilling of the coal and for superheating the water gas. The inclosure *A* is built in the usual way of fire-resisting material—such as clay, tile or brick—and is covered over its outer faces with metallic plate. It is also provided with heat-resisting and gas-tight doors and ports in the places hereinafter mentioned.

"The portion *B* of the cupola *A* may be constructed in any of the well-known forms and operated according to any of the ordinary methods of generating water gas. The parts relating thereto, as shown in the drawings, are merely for illustration.

"The form of steam inlet shown herein is made a part of the subject matter of said sole application filed by me of even date herewith.

Fig. 1.

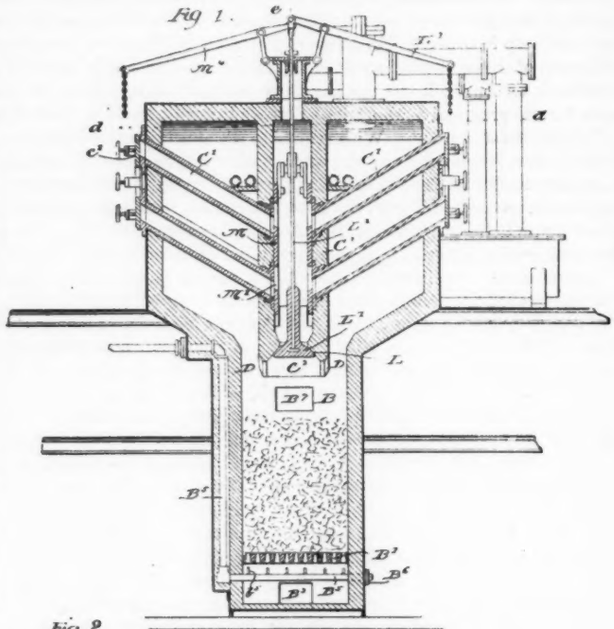
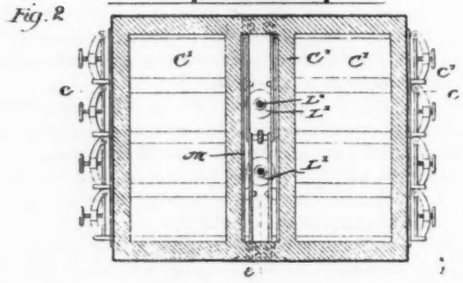


Fig. 2



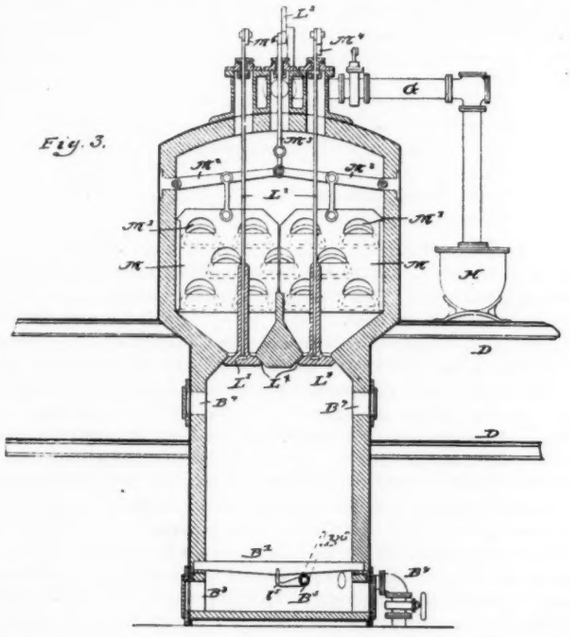
"B^1 is a common grate upon which the bed of fuel is supported. Instead of the common grate shown, rocking or revolving grates may be used. B^2 designates ash doors below the grate; B^3 designates a door above the fuel bed; B^4 is an air blast pipe leading through the wall of the cupola below the grate, and b^4 is a valve in said blast pipe. B^5 designates a steam pipe entering the cupola below the grate, by which steam is introduced to pass through the bed of incandescent fuel resting upon the grate. Said pipe may have the ordinary nozzles usually adopted for this purpose; but the drawings show an improvement upon the ordinary stationary nozzle. The pipe B^5, which is led through the wall of the cupola for additionally heating the steam, is turned horizontally in the wall of the cupola below the grate, at which point said pipe has a joint permitting the rotation of that portion of the pipe extending horizontally through the space beneath the grate and through the opposite wall of the cupola. Outside of said opposite wall of the cupola a crank B^6 is applied to and over said end of the pipe, so as to seal the latter and allow it to be turned by the moving of said crank. Nozzles b^5 extend laterally from the side of the pipe beneath the grate, and then upwardly toward the grate. When not in use said pipe is so turned as to bring said nozzles below the grate and away from the intense heat of the fire above the grate; but when the steam is to be directed into the bed of incandescent fuel the steam is turned on, and then the crank B^6 turned so

as to rotate the pipe in the proper direction to raise the nozzles upwardly between the grate bars to or into the bed of fuel above the grate, so that the steam is delivered directly into the mass of fuel and properly distributed. These nozzles b^5 are introduced to penetrate the layer of ashes or partially ignited fuel lying immediately above the grate and to penetrate through any dense layer of ignited fuel which may be formed immediately above the grate. While the steam is issuing through said nozzles they will not be materially affected by the heat of the fuel, and before the steam is shut off said nozzles should be again retracted to a suitable distance beneath the grate.

"The portion C of the cupola A is preferably expanded laterally and provided with retorts C', extending from the outer wall toward the middle of the cupola and nearly meeting at such middle, where they enter the central vertical transverse chamber C^3. Said retorts extend through the outer wall of the cupola, through the inner space of the cupola, and through the wall of the central chamber C^3, into which they open, and said retorts incline downwardly from the outer wall toward the center of the cupola. Said chamber C^3 is supported from the side walls of the cupola, and is in the form of an arch below, having at its sides the passages D. Said retorts have at their outer ends seal doors c'.

"E is an exit through the upper portion of the cupola. Upon the upper portion of said exit is a door F, and from the side of said exit a pipe G leads laterally and then downwardly into the wash-box H. From the upper portion of the chamber C^3 there is an exit I, with a lateral pipe J, leading also to the wash-box H. At the bottom of the chamber C^3 there are one or more openings L, below each of which is a head L', com-

Fig. 3.



posed of fire resisting material and arranged to be drawn upwardly over the opening L, so as to form a valve to seal said opening and isolate the space within said chamber from the general space in the cupola. The head L' is supported by the upwardly extended stem L^3, which passes through the upper wall of the exit I, and is there joined to the lifting lever L^2, or other mechanism for raising and lowering said stem and head.

"When the coal distilling retorts are inclined, as shown in the drawings, it is desirable to provide means for holding the coal positively against sliding downwardly into the chamber C^3 before the coking is completed. This I accomplish by the means of gates M M, hung adjustably in front of said retorts, and having holes M', of the size of the mouth of the retorts arranged to come opposite said mouths when said gates are lowered. Then when said gates are raised the lower portion of said mouths is obstructed, while the upper portion is open for the escape of gas. Said gates may be hung from levers M^2, M^3 and M^4, or otherwise.

"The operation is as follows: A bed of coke or coal is first placed on the grate B' to a sufficient depth for decomposing steam to form water gas, said bed being prepared with kindling or otherwise for readily igniting the same. Said bed of coke or coal may be fed in through the door B^3. When this has been done door B^3 is closed. The retorts C' are then filled with bituminous coal through the doors c'. The valves at L are closed. The door F being still open the charge upon the grate B' is ignited and the fire urged by a blast from the blast pipe B^4. The gaseous products of this combustion rise upwardly through the openings D at the sides of the arch C^3 and pass between and around the retorts C' and out through the exit E and the door F into the outer air; or they may be led thence and utilized as producer gas. By this means each of the retorts C' is well heated simultaneously with the ignition of the bed of material upon the grate. Thus the distillation of the coal in the retorts is established and continued so long as the apparatus remains hot. The gases resulting from such distillation in the retorts pass out of the inner ends of the retorts into the chamber C^3, and thence rise through the exit I and pipe J into the wash-box, and from the latter are led in the usual way for consumption. When the bed of material upon the grate B' has been sufficiently ignited for the decomposition of steam, the blast pipe B^4 and the door F are closed and the blast pipe B^5 is opened. Thus steam is delivered through the bed of incandescent material and decomposed in the well-known manner, the gases resulting being hydrogen and carbonic oxide or hydrogen and carbonic acid. If when the bed of incandescent material has been cooled the coal in the retorts has not been fully distilled, then the steam is shut off, the door F and the blast pipe B^4 again opened, and the mass of material upon the grate again raised to the required temperature, and said blast pipe B^4 and door F again closed and the steam again turned on, and so on until the coal in the retorts has been fully distilled and only coke remains in the retorts. Now the grate B' may be cleared of ashes and cinders and the mass of fuel thereon allowed to settle. Then the heads L' and gates M are lowered, seal doors c' opened, and the coke in the retorts pushed downwardly and inwardly into the chamber C^3 (if it does not run from gravity) and allowed to fall through the openings L upon the bed of burning carbonaceous fuel supported by the grate B'. Thus the coke from the retorts C' is added to the bed of fuel upon the grate, so that said bed is again of the proper depth to decompose steam. The heads L' and gates M are again raised to seal the chamber C^3 and to partially close the inner ends of the retorts C'. Then the emptied retorts are again filled with coal. Then the door F is opened and the blast of air is again turned on to blow up the mass of material upon the grate, and the new charges of coal in the retorts are heated and distilled. It will be seen that when the distillation is progressing and the water gas is being formed by the decomposition of the steam the two kinds of gas are being formed simultaneously and pass separately into the wash-box. This is done when it is desired to mix the two kinds of gas and consume them as a mixture. It will be seen, however, that the two pipes G and J may lead to distinct wash-boxes and the latter communicate with distinct mains or holders, so that each kind of gas may be consumed separately for the purpose desired. Either or both of the gases may be carbureted by mixing the same with vaporized petroleum or other liquid hydrocarbon. As the process of carbureting such gases is well understood, I deem it unnecessary to illustrate the same.

"It is to be observed that the entire inclosure or cupola A is a unitary heated chamber, and that the coke produced by distilling the coal in the retorts does not leave said chamber, but remains and is consumed therein, it being transmitted only from one portion of said chamber to another. Thus the heat of the coke is preserved to aid in burning it when it reaches the fuel bed. It is also to be observed that by this means the mass of heated coke is not exposed to the outer air so as to discharge into the latter any gases."

Train Lighting by Electricity.

Engineering, in discussing this subject, notes that among the numerous papers read before the International Railway Congress recently held at Paris, few, if any, possessed as much practical interest and importance as the joint communication of M. E. Sartiaux, chief engineer to the Telegraph Department of the Northern Railway of France, and M. L. Weissenbruch, engineer to the Belgian Post and Telegraph Department. This paper, which is of great length, deals with the present development in the applications of electricity to railway service, under the three special headings of lighting trains, and stations, and in working brakes. The subject has already been brought before the Congress at its meetings in 1885 and in 1887, but since the last date progress has been so rapid and the work of the last two years so important, that the paper is full of novelty and valuable information. We propose to extract from it, necessarily in a brief manner, the principal information it contains; and which has been collected by its joint authors with considerable trouble. After pointing out the advantages to be gained by the substitution of electricity for oil or gas, and the necessity for increased light

in railway carriages, demanded by the public, the authors refer to the early efforts to illuminate trains with the use of primary batteries. These trials, carried out in England under the Holmes and Burke system, and in Belgium by the Desruelles system, were abandoned after a time as being impracticable, chiefly on account of high cost, though the light obtained was not very good. The Desruelles system was tried in 1887 by the Orleans Railway Company, and only given up by them after careful experiment. One feature of the Desruelles battery was the substitution of bichromate of soda for bichromate of potash, to increase the electromotive force, and obtain greater uniformity; with 28 of his cells, arranged two in quantity and 14 in tension, weighing altogether 1,000 lbs., and secured to the frame of a carriage, M. Desruelles proposed to feed nine 6-candle Kriemensky lamps for 24 hours, that is, for the round trip from Paris to Bordeaux and back. A first trial made with two carriages standing resulted in failure, from short circuiting and breaking down of the lamps; a second trial with Edison lamps gave better results, but a maximum of only four candles per lamp was obtained, falling to three candles at the end of 12 hours, and to half a candle after 24 hours. The power was largely below what was necessary to maintain the luminosity required, and as half a ton of batteries was the utmost that could be stored under a carriage, to say nothing of other objections, the experiments were abandoned. In the United States, lighting trains by primary batteries was tried on the Boston and Albany Railroad* for a few days, and on the New York Central* for two or three months, but in each case with the same result.

The introduction of secondary batteries opened a new prospect for electrically lighting trains, and one that widened with the improvement and advancement made in the construction of accumulators. The efficiency which at the commencement scarcely reached 50 per cent., now exceeds 80, while the discharge capacity attains 12 ampere-hours per kilogramme of active plates, and 8 ampere-hours per kilogramme of total weight of battery. In a recent but not sufficiently tested type the duty has risen to 20 ampere-hours per kilogramme of plate. Experience, extending over a long time, on the Pennsylvania and the Boston and Albany Railroads, goes to prove that a practical minimum efficiency of from 60 to 65 per cent., with a discharge capacity of 10 ampere-hours per kilogramme of electrode, may be steadily relied on. As it is more easy to apply reflectors to incandescence than to oil lamps, those from six to eight candles appear to give sufficient light, and preference is given to types of from 23 to 28 volts. With such a potential a current of from .6 to 1.3 amperes is sufficient, and as the discharge electromotive force of each element varies from 1.95 to 1.75 volts with a normal current, the number of accumulators required for an installation can be decided by taking as a base 2 volts per accumulator, and adding a few spare batteries for throwing into the circuit as the charge becomes exhausted. On the Northern Railway of France an automatic rheostat is employed, regulated at starting according to the current consumed by the lamps collectively in a carriage; the same device serves as a commutator for lighting and extinguishing the lamps. The number of hours of lighting may be calculated on a discharge of 10 ampere-hours per kilogramme of electrode, the amount of charge equalling 15 ampere-hours. The duration of accumulators in their present perfected form seems very variable. From 5 to 10 per cent. deterioration of the negative plates appears ample, but for the positive plates 30 per cent. would seem to be exceeded. On the Boston and Albany Railroad the cost of this part of the repairs of batteries amounted to 43 per cent.: the Julien Accumulator Company, of Brussels, undertakes the repairs of complete installations at 12 per cent.; the Blanc Factory at Marly-le-Grand fixes the cost at 10 per cent.; and the Faure-Sellon-Volkmar Company at 6 per cent. The experience gained on the Northern Railway of France points to 25 per cent. as a safe proportion for repairs in train intallations, where the vibration tends to affect the duration, and the same percentage is accepted by some authorities in the United States. The lamps employed may be credited with a life of 800 hours, a period that, with improvement in manufacture and suspension, may be reasonably expected to increase by 50 per cent.

The Paris and Orleans Railway Company was amongst the earliest to experiment with train lighting by accumulators, their trials commencing in 1883, but they do not appear to have been of long duration, and the results obtained not being found satisfactory, the idea was abandoned, and oil lamps of the Shallis and Thomas type, two in a compartment, were adopted. It is needless to point out that a great advance has taken place since 1883, and that this experience of the Paris and Orleans Railway Company is interesting chiefly in an historical point of view. On the Pennsylvania Railroad the first trials took place in April, 1885, when eight drawing-room cars were furnished each with ten Brush-Swan 12-candle lights of 45 volts and 1 ampere, and with 24 batteries of the Brush-Plante type, weighing altogether 2,640 lbs., and coupled in series; they were charged with a Brush dynamo over a period of about 17 hours. This experiment proved a failure, because the batteries were unsatisfactory and difficult to handle, and the lamps were unsuitable. Later on, accumulators made by the Electrical Accumulator Company, together with different lamps and modified arrangements, have given great satisfaction. On the Boston and Albany Railroad* the 4.30 P. M. train from Boston to New York is lighted by electricity. Each car has 22 lamps, of which two are on the end platform, 16 in the car, and the remainder in the vestibules and lavatories; they were originally of the Weston type, but are being replaced by Edison lamps. The batteries are of the Julien pattern, and comprise 60 accumulators placed under the car in two groups of 27 each in series, and three reserves that can be switched on. The total weight of each element is 37 lbs., and they are charged without being removed from the car when the train is on a siding; only nine hours' lighting are required, but a reserve of two hours is always available. The duty obtained is about 60 per cent. As for the cost of this installation, it appears to amount to about £180 per carriage with 22 lamps and a duration of ten hours; the price is made up as follows:

Sixty batteries	£151.4
Twenty-two lamps and suspension	8.8
Wiring, commutators, etc	20.0
	£180.2

or nearly £8 4s. per lamp. According to the *American Railroad Gazette* this price is higher than the present cost of an installation, which should not amount to more than £6 4s. per lamp. The cost of working amounts to about ¼d. per lamp per hour, the charges being approximately as follows, according to MM. Sartiaux and Weissenbruch:

Interest at 4 per cent.	$7.20
Depreciation of accumulators, 30 per cent.	45.36
Renewal of lamps every two months.	26.40
Sinking fund at 5 per cent.	1.26
Charging batteries, 365 days	54.75
Salaries, etc	14.60
Total	$149.57

It is stated, however, that the cost for recharging is considerably higher than that given above; that it is double, in fact; which adds about 30 per cent. to the total expense.

The Pullman Palace Car Company, the Canadian Pacific Railway, and the North-East Railway of Switzerland, have all made more or less complete trials; the last named company conducted their tests with a view to comparing the efficiency of the electric light with that of the Pintsch compressed gas; it is stated that the light is much better, and that the weight of gas reservoirs is double that of the accumulators for the same number of burners and length of service. The Western Swiss and Simplon Railway Company lighted one of its passenger trains last December with seven 18-volt Kotinsky lamps, requiring a total current of 9.6 amperes; each lamp is provided with a hand switch. Huber accumulators, nine in number, supplied by the Blanc Factory at Marly-le-Grand (Fribourg), are employed. The total weight of batteries is 341 lbs., and the capacity of each element is 120 ampere-hours, the duration of possible lighting being 12.5 hours, a time long enough for two days' supply. The batteries are exchanged at Fribourg, where they are recharged, which occupies from 4½ to 6 hours; after four months' working the accumulators showed no signs of deterioration, and the lamps were still good after 800 hours' service. The cost of the installation was as follows:

Accumulators	£14.0
Seven lamps with suspensions	4.2
Installation	4.0
Total	£22.2

or 62s. 5d. per lamp. Approximately the cost of working may be estimated as follows:

Interest at 4 per cent	£0.888
Depreciation at 25 per cent	3.150
Renewal of lamps after 800 hours	3.192
Sinking fund, 5 per cent.	.410
Charging batteries	4.380
Salaries, etc	7.280
	£19.300

or somewhat over 1s. per day.

* At the present time the proprietors of both these railroads are preparing to light all their passenger trains by means of compressed gas.—Ed. A. G. L. J.

* System abandoned on Nov. 1st. The cars are now being fitted with the Pintsch system of gas lighting apparatus.

The Northern Railway Company of France has for a long time been actively engaged in experimenting in a different direction; they are seeking to replace the oil lamp with an independent electric light fed by a portable secondary battery. The trials are not sufficiently far advanced to make any positive deductions, but it may be mentioned that the carriages of the club train between Paris and Calais are thus lighted, and the system will be extended for the same service between Dover and London, and for the tramway trains of the Nord from Paris to St. Denis, St. Ouen les Docks, and Pantin. Each carriage of the club train is lighted by 22 lamps (Breguet) of 25 volts and from .6 to .7 ampere, each giving 6 candles; it was found after a short time that 21 lamps gave ample light. They are arranged in two rows, alternating for better diffusion. These lamps are fed by 16 batteries of 7 plates, and weighing each 68.2 lbs.; they are of the type made by the Societe de Travail Electrique des Metaux, and are placed under each carriage in a somewhat novel arrangement devised by M. Eug. Sartiaux. The batteries are placed in four rows in a sheet iron box, measuring 50 in. in length by 30 in. in width and 9.84 in. in depth. They are all connected in series, and a hand rheostat is introduced in the circuit, which is fixed so long as the potential ranges between 25 and 26 volts, but if this falls, the lock is removed, and the attendant, guided by a failure in the light, can reduce the resistance. The box containing the accumulators is like a drawer sliding on rollers inside a sheet iron carriage; the total weight of this part of the installation is 1,210 lbs., and the capacity of each battery is 170 ampere-hours, and the practical light duration is 15 hours. Arrangements are made by which the accumulators throughout the train are charged simultaneously without removing them.

This system has not been long enough in use to give reliable information as to cost; so far as efficiency is concerned it is well spoken of. M. Sartiaux makes the following estimate, which he considers certainly does not understate the cost.

1. Price of installation—

Battery and box, etc	£46.40
22 lamps, with reflectors, brackets, etc	18.00
Wiring, commutators, and labor	6.40
Total	£70.80

2. Cost of maintenance—

Interest at 4 per cent	£3.115
Depreciation of batteries, 15 per cent	5.760
Renewal of lamps after 1,200 hours	9.240
Sinking fund, 6 per cent	1.760
Charging batteries	12.848
Salaries, etc	29.208
Total	£61.931

—about 3s. 6d. per day, or less than 1d. per lamp-hour. The list of railway companies that make use of electric lighting on trains, solely by the use of accumulators, may be closed by a reference to the Helsingborg-Christiana line in Sweden, on which most of the through trains are thus lighted, and some of the most important trains between Melbourne and Adelaide, a run of 18 hours, where for more than a year the Julien batteries have been at work.

The second system considered is that in which a combination of accumulators and a dynamo driven from one of the axles of a vehicle is employed. The London, Brighton, and South Coast Railway Company has long used this system, and trials were made with it on the Belgian State and the Eastern of France Railways as long ago as 1883. In the early trials the accumulators, placed in a van beside the dynamo, only served to feed the lamps when the train stopped, and all connection was severed automatically between the dynamo and batteries when the speed of the train fell below a certain minimum—about 22 miles per hour; the introduction of resistances and the movements of the commutator were all effected by hand. Later, the regulating action of the secondary batteries was discovered, and they were then always maintained in the lamp circuit, and this was early adopted by the London, Brighton, and South Coast Railway Company. On the Sudbahn the Calo system was adopted, in which the principle of regulating by accumulators was carried further by means of an automatic centrifugal commutator that served as a safety cut out, and introduced into the circuit a variable number of secondary cells. These auxiliary elements were connected in two parallel series, so that their regulating influence should be more complete, the resistance less, and the electromotive force more uniform. This train ran for a long time between Trieste and Vienna, but the system was ultimately abandoned.

Passing over a system devised by Loebbeeke and Oestreich, and rejected after trial by the Frankfort-on-Main Company, as being too complicated, we come to experiments made by the Wurtemberg State Railways. Here the accummulators were placed in derivation in each carriage, so as to make it independent, and it was found that both in charging and discharging compensations were produced that balanced the differences existing in the different batteries. An electric device applied to the brushes of the dynamo permitted the latter to run in both directions, and resistances were automatically introduced into the circuit as the electromotive force increased; by the same device the dynamo was cut out of the circuit when the train speed became less than 22 miles an hour. In a further modification all the batteries feeding the lamps are connected together by two supplementary conductors, which allow—by compensation current—carriages, the accumulators of which are not fully charged, to be made up in the train. Considerably greater success appears to have been achieved in this country by this mode of lighting than on the Continent. Thus, on the London, Brighton, and South Coast Railway, there are three main line trains and thirteen local trains thus lighted. The electromotive force of the dynamo varies from 50 to 80 volts, and the current from 35 to 80 amperes, according to speed; in the local trains there are 22 accumulators, and in the main line trains 32; the former are provided with 40 lamps of 12 candles and 42 volts, and the latter with 70 lamps of 10 candles and 60 volts. On the Great Northern Railway four trains of 10 carriages are lighted on the same system. These are worked on suburban traffic, and the light is required during the day on account of tunnels. On the Midland Railway extended trials are being made, the system being similar; on the Taff Vale Railway two trains are in regular service, but the Southeastern Railway Company, which experimented on the Stroudley and Houghton (London, Brighton, and South Coast) system, have discontinued their trials for the present.

As regards the cost of installation and maintenance, the only figures advanced by MM. Sartiaux and Weissenbruch are those connected with the Wurtemberg State line, where experiments were carefully conducted, and where it was found that the cost per lamp for an outfit of 39 lamps was £15 16s., and the expenses of working averaged somewhat less than ½d. per lamp-hour. It was mainly on account of the heavy first-cost that the experiments were abandoned, and it is to be supposed that where this mode of lighting is adopted on English lines the expenses of installation are much smaller.

The third system of train lighting considered is that in which accumulators and a dynamo are used, the latter being driven by a steam motor. This method was tried to some extent on the Great Western Railway in 1884, and on the Great Eastern Railway during the same and following year; this installation was curious, inasmuch as the Tower rotary engine was employed to drive the dynamo, which, with a battery of 26 accumulators placed in the guard's van, lighted a train of 15 carriages. The results obtained with this installation were excellent, but the cost interfered with an extension of the system. A very interesting installation was that on the Imperial Russian train destroyed in the accident of October, 1888. The work was carried out by the Jablochkoff Company, of St. Petersburg, and the dynamo was driven by a 3-cylinder Brotherhood engine. The whole of the power installation, engine and boiler, water tank, and 36 accumulators were arranged in a 4-wheeled car especially built for the purpose. In a separate compartment were placed a train speed controller and a Schwarzkopf boiler safety apparatus. The train comprised 12 vehicles—a kitchen, buffet, dining room, and 9 saloon cars—besides the baggage wagon, the electric car, and a repairing car. In all there were 253 lamps in the train; these were each independent of the others, and could be lighted or extinguished at will by pulling one of two cords. In the buffet car was placed a battery of 18 accumulators, and a similar one was fixed in the dining room carriage. All three groups were charged from the engine and dynamo, the former having been of 15-horse power. Of course this cannot be regarded as a commercial installation, but the figures of actual construction charges are interesting:

	Roubles.
Boiler, engine, and dynamo	8,810
Wiring	7,515.89
Measuring and recording apparatus	758
Commutators and cut-outs	888.50
Accumulators	3,960
Lusters, brackets, and fittings	4,173
Labor, experiments, etc	2,823.60
Total	28,928.90

—or about £17 per lamp.

After a preliminary trial of 24 hours with the train stationary, a run was made from St. Petersburg to Moscow—about 400 miles, including a

10 hours' delay at Moscow. During this trip the lighting was maintained for two hours solely by the accumulators. Afterward the train ran about 5,000 miles, the installation remaining in perfect order until the accident, when, curiously enough, the electric wagon that followed the second engine was undamaged.

In America, the New York and Chicago Limited Mail is lighted with an Eickemeyer dynamo driven by a Brotherhood 3-cylinder engine of 10 horse power, and feeding groups of accumulators distributed through the train, and which, before the addition of the engine and dynamo, served, but not with entire success, to light the train. The engine runs continuously to charge the batteries during the day, and to supplement them at night. The exhaust steam is employed in winter to heat the cars. On the Connecticut River Railroad a somewhat similar installation is at work on a passenger train running between Springfield and Northampton; it includes 71 lamps, a high speed 7-horse power engine with dynamo, and a battery of 24 accumulators, which are placed in the baggage car. The cost of this installation was £500, or about £7 per lamp. The expense of working is as follows:

Interest on capital, 6 per cent	£30
Lamp renewals	10
Sinking fund	20
Repairs and attendance	6
Coal and stores	31.2
	97.2

Or less than one-fifth of a penny per lamp-hour. On the Chicago, Milwaukee, and St. Paul Railway there are two vestibule trains running with apparent success, and the system is also in use on the Grand Trunk Railway, the Canadian Pacific, and the Intercolonial Railways.

The last means of lighting to be referred to is that in which current is sent along the track through a central rail. The Glasgow City and District Railway offers an example of this kind established through the tunnels. Current is brought through an insulated central rail, the circuit being completed by the ordinary rails; contact with the former is assured by means of two wheels beneath each carriage, mounted on springs; the central rail is kept clean by brushes. This central rail is divided into three separate parts, the cross-sections of which decrease with the distance from the dynamo in such a way that the maximum fall of potential does not exceed 10 volts; the working potential is 110 volts; the loss from imperfect insulation does not exceed 3 amperes. Eight trains a day run through these tunnels, representing a total of 74 coaches. A similar installation is in service within three tunnels on the railway between Kieff and Odessa.

As regards the cost of electric lighting compared with that of oil and gas in trains, MM. Sartiaux and Weissenbruch come to the following conclusions:

1. That the cost of electric lighting by accumulators alone, charged at fixed stations, varies, in the United States, from 5 centimes to 5.6 centimes with lamps of from 12 to 16 candles, and that in Europe the cost is from 1.9 to 3 centimes for lamps of from 6 to 8 candles per lamp-hour.

2. From experience obtained in Europe, it is possible to charge accumulators by a dynamo driven off the axle at a cost not exceeding 5 centimes per lamp-hour for 5-candle lamps.

3. That in the United States the cost of lighting varies between 3.5 and 5 centimes per lamp hour for 16-candle lamps in installations comprising accumulators, dynamos, and an engine supplied with steam from the locomotive.

On the Continent the cost of Pintsch gas per lamp-hour (5 to 6 candles) is 3.764 centimes, and of colza 5.635 centimes,

In view of all that has been effected in this direction, the Swiss Railway Union, at a meeting held on Nov. 2, 1888, formulated the following resolution: "That, considering the actual position of electric lighting, it is not desirable to extend the lighting of trains by gas, but that it is preferable to continue the investigation of the electric lighting problem, and to extend experiments." The recommendation of MM. Sartiaux and Weissenbruch met with the full approval of the Railway Congress, to the effect that such experiments should be actively pursued by the various railway administrations, all of which have a common interest in the subject.

THE Cincinnati Gas Company is now paying an interim dividend of $2.50 per share. In the official notification of the declaration it is also explained that subscriptions to the stock of the Cincinnatti Electric Light Company (which is to be in effect an annex to the Gas Company) will be received only from stockholders in the Gas Company, each subscriber to have the right to take as many electric shares as will equal his holdings in gas shares.

The Estimation of Ferrocyanogen in Spent Gas Purifying Material.

Dr. O. Knublauch, Chemist to the Gas and Water Company, of Cologne, Germany, has caused to be published in the German *Journal af Gas Lighting* the following respecting his researches on the subject, which compilation represents the work of many years. He says: Ferrocyanogen may be easily determined in pure ferrocyanogen compounds; and it is only when exact determinations on impure products are required, that difficulties crop up. Spent gas-purifying material contains ferrocyanogen in an insoluble form; and, in addition, a great number of other compounds, some of which are soluble in water, whilst others dissolve in the alkalies or alkaline earths which are used for the extraction of the ferrocyanogen. As examples of such compounds, thiocyanates, sulphur compounds, free sulphur, ammonium salts, and particles of tar, carried over mechanically, are always present in these matters. Now, when the estimation of ferrocyanogen is made by titration with copper solution (as, for example, in Bohlig's method), the impurities act deleteriously, either by reacting with the copper solution, or by interfering with the distinctness of the final stages of the titration; whilst titration with permanganate is quite useless for the purpose, for, even after getting rid of the thiocyanates, there remain large quantities of other substances oxidizable by permanganate. If it is desired to estimate the iron present as ferrocyanogen in the extract, with the object of ascertaining the quantity of ferrocyanogen, there is the objection that it is difficult, if not impossible with our present knowledge of the composition of ferrocyanogen compounds, to state definitely that the iron estimated really exists in the form expressed by the usual formula.

It is first necessary to eliminate all iron not present as ferrocyanogen—an operation which is somewhat uncertain in the presence of such various organic compounds. In fact, the assumption that the complete precipitation of the iron is prevented by the presence of such compounds is justifiable, until there is proof to the contrary. Moreover, compounds resembling ferrocyanogen in their behavior with alkalies and alkaline earths, are also produced in gas-purifying material; but they are of little or no value to the consumer. When these compounds are present, the end reaction is not sharp. The precipitates produced by ferrous salts are greenish, whilst after titration with copper solution the liquid is greenish yellow. As, however, these compounds are present in relatively small quantities, it must not be asserted off-hand that a process is useless because it is based on the estimation of iron, although it would be difficult to prove experimentally that the above considerations are unfounded. The molecular weight of potassium ferrocyanide, as compared with that of iron, is as 422.8: 56; therefore the amount of iron found by analysis has to be multiplied by 422.8÷56, or 7.55; in order to transform the numbers obtained into proportions of potassium ferrocyanide. It will thus be seen that the error produced even by a small quantity of iron not present as ferrocyanide may become considerable.

In the course of the author's experiments on the formation and estimation of ferrocyanides, it has happened that iron hydroxide has separated from the solutions. In this way, therefore, iron previously present as ferrocyanide may become removed from solution, and escape being estimated. In both these circumstances, the numbers obtained for iron would not lead to correct results. The numbers would come nearer the truth with material that did not contain any ammonia before purification; with that which had been utilized as much as possible, and contained but little thiocyanates or ammonia; and with that which had been well revivified subsequent to its being used in the works. In many other cases, however, errors are inevitable.

Another way of estimating the ferrocyanide is to ascertain the amount of cyanogen or nitrogen, and to calculate the ferrocyanogen from the results. But here also difficulties are met with—in thiocyanates, for instance—which would affect the calculations much as when the quantity of iron is taken as the basis. No absolutely accurate method is known for the determination of the commercial product; it is therefore best to select one which will throw some light on the technical value of the material, and which is founded on the same operations as are applied in preparing the valuable products from it. On this basis the following scheme appears to be the safest: Conversion of the insoluble into soluble salts, purification of the extract, and estimation of ferrocyanide direct with copper solution—a plan found to work satisfactorily by the author.

Before proceeding to give the details of the process, the author describes experiments to show how far the various operations involved are admissible, and also what degree of accuracy may be expected from the method. The points investigated are: (1) The temperature to which the mass may be exposed for drying, without suffering decomposition.

(2) the manner of converting the ferrocyanogen from the insoluble into the soluble form, at the same time avoiding, as far as possible, the introduction of objectionable compounds into the solution. (3) The removal of these ojectionable compounds from solution. (4) The method of rendering most distinct the termination of the titration with copper solution.

With regard to the preparation and drying, the importance of careful sampling is first set forth, especially in heaps of varied composition, containing not only lumps of iron hydroxide, which are most likely unacted upon in the interior, but also pieces of other materials. The sample must be crushed and subdivided as rapidly as possible, and dried. The author finds that temperatures between 50° and 60° C. for five to six hours are safe; but at 100° to 110° C., slight decomposition ensues. It is thought best to expose the mass to the former temperature (50° to 60° C) until a constant weight is obtained, then to pulverize and pass through a sieve of 360 meshes to the square centimeter.

The next point is the conversion of the insoluble ferrocyanides into a soluble form. Boiling with alkali or lime dissolves sulphur, and introduces into the solution many other interfering substances. Experiments were therefore made with cold solutions; and it was found that to insure complete decomposition of the insoluble ferrocyanides, the alkali must be sufficiently strong, in large excess, and in contact with the mass for some time. Ultimately the strength is fixed at a 10 per cent. solution of potassium hydroxide, to be used in proportions of 50 c. c. to each 10 grammes of material, which are to be left in contact for 15 hours with frequent agitation, or, if only approximate results are required, three hours' contact will be sufficient. The results of other experiments show that the purification of the extract may be efficiently effected by treatment with an acid solution of ferric chloride. If sulphureted hydrogen is also present, it may be removed by means of lead carbonate. The latter, however, should not be resorted to unless the sulphureted hydrogen reaction is very pronounced; and after the use of lead the filter titration must be used for calculations, as the lead appears to interfere with the spot test. Small quantities of sulphureted hydrogen only exert an unimportant influence on the result; and therefore it would be well if the seller and purchaser agreed under such circumstances that treatment with lead was not to be introduced. The completion of the titration is ascertained by testing some of the solution with ferric chloride, which gives a blue coloration as long as any potassium or other soluble ferrocyanide remains in solution. So long as the quantity of ferrocyanide in solution is moderately large the blue coloration is instantly produced and is very pronounced; but as the quantity diminishes so does the rapidity of the formation and the distinctness of the blue coloration also fall off. The method of testing usually employed is placing a drop of solution on filter paper, and a drop of ferric chloride a short distance from it on the same paper; then to note, as the drops of liquid spread, whether or not a blue coloration forms at the point of contact. If, however, when the titration is found to be approaching completion by this method, a small quantity of the solution is carefully filtered off through a small but perfect filter, and the absolutely clear filtrate contained in a test-tube treated with ferric chloride, then, owing to the depth of liquid, a very much weaker blue coloration can be seen than is possible with the spot method; and therefore the filter titration invariably comes out higher than the spot test. The same time must always be allowed, after the addition of the ferric chloride, for the appearance of the blue coloration—about two minutes for the spot test, and from a quarter to half a minute for the filter test. The same precaution must be taken after adding the copper; and all calculations must be based either on the spot or the filter titration, or the mean of the two. When sufficient copper solution has been added the blue coloration gives way to a brownish tint which can be clearly observed after filtration, especially if a very small quantity of a dilute solution of a thiocyanate is added.

After completing these investigations the author adopted the following method of analysis: The entire sample of 200 to 250 grammes is dried at from 50° to 60° C. for five to six hours, weighed for moisture, then pulverized and passed through the sieve. If any sawdust is present this remains on the sieve, and is weighed separately. Next, 10 grammes of the sifted material are treated with 50 c. c. of a 10 per cent. solution of potassium hydroxide (potash) in a flask marked at 250 c. c. and 255 c. c., either for 15 hours with frequent agitation, or for 16 hours and shaking frequently during the first and last two hours. The flask is then filled to the 255 c. c. mark and the contents filtered. Next, 100 c. c. of the filtrate are run into a hot solution of ferric chloride, containing 60 grammes of ferric chloride and 200 c. c. of hydrochloric acid (having a specific gravity of 1.19) per liter, and filtered hot (about 80° C.) through a folded filter (13 centimeters diameter), and best covered over in a hot water funnel. The precipitate is washed with hot water, but not for too long a time. The filter is now spread out in a porcelain dish, and the precipitate decomposed with 20 c. c. of 10 per cent. potash; care being taken that none of the Prussian blue escapes decomposition. The liquid is washed into a 250 c. c. flask and tested with sodium nitroprusside for sulphureted hydrogen. Failing an immediate and distinct reaction, 50 or 100 c. c. of the filtered liquid are titrated direct, adding 2.5 c. c. or 5 c. c. of sulphuric acid (strength, 1 of acid to 5 of water). If sulphureted hydrogen is present the unfiltered liquid is treated with 1 or 2 grammes of lead carbonate, filtered quite clear and titrated. The copper sulphate solution contains from 12 to 13 grammes of the salt per liter; and it is standardized by titration with a solution of pure potassium ferrocyanide containing 4 grammes per liter. The same quantity of acid must always be added for titration, and the precautions noted above in regard to time must be observed. When precipitation as Prussian blue only has been used for purifying the extract, calculations may be based on either the spot test or the filter titration; but when lead treatment has also been resorted to, only the filter titration may be used for calculating the percentage of ferrocyanide present, which is ascertained by using the following formula, where a = the number of cubic centimeters of copper solution required for the titration of 50 c. c. of the solution containing $10 \times \frac{2}{3} \times \frac{1}{5} = 0.30$ gramme of the substance under examination; and b = the number of cubic centimeters of copper solution required for titrating 50 c. c. of the standard potassium ferrocyanide solution containing 0.20 gramme of the salt. Then, $\frac{a}{b \times 0.04}$ = percentage of potassium ferrocyanide in the substance dried at 50° to 60°.

The numbers obtained for potassium ferrocyanide may be converted into the corresponding numbers for the several cyanogen compounds by the use of various factors. If p = percentage of potassium ferrocyanide, then—

$p \times 0.511$ =	percentage of	hydro-ferrocyanic acid.
$p \times 0.678$ =	"	Prussian blue.
$p \times 0.369$ =	"	cyanogen.
$p \times 0.383$ =	"	hydrocyanic acid.

As a rule the spot and filter titrations only differ to the extent of from 0.2 to 0.6 c. c. when from 8 to 12 c. c. of the copper solution of the above strength is used; and the addition of the last 0.2 c. c. of copper solution generally results in blue coloration, changing to brownish, or even to colorlessness. There are occasions, however, when the filtrates from the copper precipitates give persistently green or greenish yellow colorations with iron. Another exception is sometimes encountered. Most filter papers contain sufficient iron to give the blue reaction without adding more iron; and with pure ferrocyanides and most samples of spent material, the results registered by spot tests made with or without added iron agree. But, on the other hand, in some instances the result recorded with iron is higher than that shown without iron; whilst the test obtained with the filter titration comes out very much higher still. This anomalous behavior the author considered to be due to the presence of substances which become converted into ferrocyanides, but which are not present as such, and should not be regarded as of equal chemical value. It is for this reason that, in the author's opinion, the percentages of iron or cyanogen are unsuitable data on which to base calculations for ascertaining the percentage of ferrocyanogen in spent material containing these particular compounds.

Many experiments were instituted to investigate the character of these substances. Firstly, it was found that the two spot tests could be made to agree by precipitating ferrocyanides twice as Prussian blue; but still the spot differed from the filter titration. To ascertain the character of this substance which caused the difference, varying quantites of copper solution were added to the extract of the spent material; and, after filtration, the filtrate was poured in hot ferric chloride solution in the usual way, the precipitate so obtained being titrated, and the solution from it filtered and subjected to a similar course of treatment. Various periods, too, were allowed to elapse between the experiments. More washing was tried; and more agitation, and sundry other alterations in the conditions of experiment, were essayed. The result was that the solutions were found to contain substances which either impeded the precipitation with copper sulphate or which yielded ferrrocyanides in small quantities by being decomposed. It was therefore suggested that whenever the anomalous behavior is observed, the material should be treated in the following manner, in order to ascertain its true value: Add somewhat more copper sulphate than that indicated as necessary by a preliminary spot test; for if too little copper solution is added, even pure ferrocyanides gives anomalous results. Then precipitate the filtrate from this copper precipitate with ferric chloride; decompose and titrate. In order to get sufficient of the second precipitate, more of the

original solution may be employed. A further treatment of the solution from the tritration of the second precipitate may be carried out, if it is thought desirable. In this way numbers will be arrived at which may be added as corrections to those obtained in the usual manner; and it will be found that the spot and filter titrations become more in accordance with one another—the former increasing while the latter decreases. When material has stood for some time, it ceases to behave in this anomalous manner; and apparently the disturbing substances disappear. This accounts for their general absence in material which has been stored for a lengthened period, or which has been revivified. The disturbing substances appear to contain varying quantites of iron and cyanogen, and also a small amount of sulphur. In their presence the spot test gives results too low; and the filter titration yields results above the truth. The only alternative for the fractional titration just described is an agreement between the vendor and purchaser as to what estimation is to be taken as representing the value—perhaps, for instance, a mean of spot test without iron and a filter titration. The anomalous materials are not frequently met with in Cologne; and therefore the ordinary method described by the author generally answers. It must be remembered that the value of the stuff depends not only on its power of absorbing sulphureted hydrogen, but also on the amount of ferrocyanogen contained in the spent material, and the larger the proportion of the ferrocyanogen to the sulphur, the greater is its value.

Experiments on a Steam Engine, the Cylinder of which was Heated Externally by Gas Flames.

At a meeting of the Institution of Civil Engineers (England), Mr. Bryan Donkin contributed the following:

In the following experiments an attempt has been made to determine how far cylinder condensation can be prevented, and an economy of steam realized, by heating an engine cylinder externally by gas flames, so as to raise its temperature considerably.

The engine was of the horizontal single cylinder type. Diameter of cylinder, $8\frac{7}{16}$ inches; stroke 14 inches. It was coupled direct to a rotary gas exhauster used merely to pump air so as to absorb the power. One set of experiments were made non-condensing and one set condensing. In the latter case communication was made with the condenser of a factory engine, so that the air pump discharge of the experimental engine could not be measured. The feed water was carefully measured in all the trials, and indicator diagrams were taken frequently from both ends of the cylinder.

The arrangement of the gas jets was necessarily somewhat imperfect; but every care was taken to insure accuracy in recording the results. Several experiments were made both with and without the gas flames. When using the gas flames the quantity of gas burned was varied. The Bunsen burners were placed quite close to the cylinder externally, and the flames reached about half-way round the cylinder. External radiation was prevented as far as possible by sheets of asbestos, the products of combustion passing away through holes left in these sheets. The expansion was constant in all the experiments, as there was no separate expansion valve.

Results of the Experiments.—These are given in the following tables. It will be seen that the temperature of the cylinder wall when the gas flames were used was generally much above that of the steam admitted.

There is a decided economy of steam when the gas flame jacket is used, but against this must be set the cost of the gas used. This will vary in different localities, and the commercial gain will be the difference of cost of the fuel saved and the gas used.

Since these experiments were made, a better mode of burning the gas has been adopted.

Professor Dwelshauvers Dery, of the University of Liege, was much interested in this novel way of heating the cylinder, and, at his request, copies of the results were sent to him. He has carefully analyzed these results, and compared them with experiments in which two other ways of reducing cylinder condensation were used. In Mr. Willans's experiment the amount of cylinder condensation, reckoned per indicated horse power, is reduced by increasing the speed of the engine. In Professor Hirn's experiments the condensation is diminished by superheating the steam. The comparison of the economy obtained by these three methods is instructive.

Table I. With and without Gas, Non-condensing.—Comparing experiment No. 3 with No. 9, there is an economy of 24 per cent. in feed water indicated horse power per hour, and this with practically the same pressure of steam, power, speed and expansion. It will be noticed that the external temperature of the cylinder walls was much greater with the gas burning than without. The initial pressure of steam of the indicator diagrams was also about 3 lbs. greater, say 10 per cent., with the gas than without. As to the steam calculated from the diagrams at $\frac{5}{16}$ of the stroke, 80 per cent. only of the total steam supplied appeared in experiments without the gas flame jackets, and 20 per cent. was missing; while, on the other hand, with gas jacket on, the diagrams showed that at $\frac{5}{16}$ of the stroke all the feed water was present as steam, there being no missing quantity.

TABLE I.—*Summary of Experiments on a Six-Horse Power Non-Condensing Steam Engine, with and without Gas Flame Jacket, at Bermondsey*, 1888.

	Without Gas Jacket.	With Gas Jacket.		
Experiment	No. 3	No. 6	No. 9	No. 8
Date, 1888	July 26	July 28	July 31	July 31
Duration	4 hours	4 hours	....	3 hours
Feed water—				
Feed water per I.H.P. per hour	44.4 lbs.	34.1 lbs.	33.8 lbs.	34.8 lbs.
I.H.P.—				
I. H.P. by diagrams	6.26	6.17	6.33	6.31
Ordinary London gas—				
Gas burnt in Bunsen burner per hour	0 cu.ft.	49 cu.ft.	40 cu.ft.	35 cu.ft.
Temperature—				
External temperature of cylinder walls at top	248° F.	414° F.	....	335° F.
Steam pressure above atmosphere—				
Boiler pressure	35.5 lbs.	35.4 lbs.	35.4 lbs.	34.5 lbs.
Initial pressure in cylinder	31.7 lbs.	34.7 lbs.	34.7 lbs.	33.8 lbs.
Speed—				
Revolutions per min. (by counter)	90.73	90.79	89.7	90.1
Total revolutions	21,776	21,790	16,147	16,218
Steam from diagram—				
Steam per I.H.P. per hour, calculated from diagrams at $\frac{5}{16}$ stroke (lbs.)	35.87	34.42	34.37	....
Percentage of steam used, shown on diagrams at $\frac{5}{16}$ stroke	80	101	$101\frac{1}{4}$	....

TABLE II.—*Summary of Experiments with Same Six-Horse Steam Engine, but Condensing, with and without Gas Flame Jacket*, 1888.

	No Gas Jacket.	With Gas Jacket.	
Experiment	No. 4	No. 3	No. 2
Date, 1888	Aug. 9	Aug. 9	Aug. 8
Duration	3 hours	3 hours	3 hours
Feed water—			
Feed water per H.P. per hour	38.5 lbs.	30.7 lbs.	30.3 lbs
I.H.P.—			
I.H.P. by diagrams	5.61	6.05	5.47
Ordinary London gas—			
Gas burned per hour, Bunsen burner	0 cu.ft.	35 cu.ft	28 cu.ft.
Temperature—			
External temp'ture of cylinder walls taken at top	213° F.	239° F.	240° F.
Steam pressure above atmosphere—			
Boiler pressure	35.0 lbs.	34.5 lbs.	34.5 lbs.
Initial pressure in cylinder	14.8 lbs.	15.3 lbs.	13.2 lbs.
Speed—			
Revolutions per minute (by counter).	92.27	92.66	90.16
Total revolutions	16,680	16,680	16,230
Steam from diagram—			
Steam per I.H.P. per hour, calculated from diagrams at $\frac{5}{16}$ stroke	28.3	27.3	27.3
Percentage of steam used, shown on diagram at $\frac{5}{16}$ stroke	73.5	89	90

Table II. With and without Gas, Condensing.—Comparing experiment No. 4 with No. 2, there is an economy due to the gas flame jacket of 21 per cent. in feed water per indicated horse power per hour, with about the same pressure of steam, power, speed and expansion.

The temperature of the external cylinder was greater with the gas.

The initial pressure of steam was also greater with the gas. In the steam calculated from the diagrams at $\frac{5}{16}$ of the stroke, 73 per cent. only was shown on the diagrams in the experiments without the gas flame jacket.

In the experiments with the gas flame jacket 90 per cent. of the total steam used was shown on the diagrams, or a diminution of condensation of 17 per cent.

Comparing the two sets of experiments, Table I. and Table II., the jacket gives a rather greater effect in the non-condensing set than in the condensing. The experiments made with increased quantities of gas show that after the cylinder metal had been raised to a certain temperature the extra quantity of heat seemed to have no beneficial effect whatever. Probably the extra heat was partly radiated externally and partly passed away with the exhaust.

A few trials were made at 45 revolutions, and there was still an economy due to the gas flame jacket, but not nearly so marked as at 90 revolutions.

Mechanical Progress—the Past and Present Contrasted.

[A paper read by Mr. George B. Price, before the Franklin Institute, and reprinted from the Society's *Journal*.]

The purpose of this paper is to indicate something of the wonderful growth of our manufacturing industries in the last 20 years, and to call attention to the wide difference in systems, marking this from previous epochs, especially the introduction of the draughting room as one of if not the chief factor in promoting this unparalleled growth of mechanic arts.

To show the invariable superiority of one method over all others for accomplishing a purpose, and to be able to prove by many notable examples the unquestionable value of such method, is to show at once the road by which the live men of to-day are winning a deserved success, and a very possible cause of partial failure to those who are yet unacquainted with the very radical change in the situation.

Nothing is truer to this century than the oft-heard phrase "The world moves on."

Time was when men were satisfied with candle light.

The ship in which Columbus sailed was doubtless looked upon as a noble craft. Men for centuries plowed the earth with wooden plowshares, and the smith at his forge was the nobleman in mechanical skill.

Our century, with its myriad wheels of invention, looks back upon those times as upon a world in its infancy. It was in its infancy. Then men toiled as best they know how, and with commendable zeal constructed the argosies that have floated humanity to the portals of a new age.

From those portals a new light is shining with promise of untold wealth. The rapid accretion of knowledge in the scientific world has evolved principles that men knew nothing of, even a century ago; but which, being recognized and practically applied, are stimulating the great world of industries, abrogating the old and instituting revised methods, to such an extent that men have now grown perfectly familiar with the quotation that "things are not now done as they used to be." How very true! Instead of a small wooden hull, drifting uncertainly upon an almost impassable sea, we have now the advantage of swift and massive "ocean greyhounds," whose grace and perfection tell of a new world of mechanic arts. The smith at his forge, toiling with scarce-requited labor to express in rude form the conceptions of his individual brain, has given place to our splendid machine shops and great foundries, equipped with "plant" that now makes easily possible what once had been more than a Utopian dream.

The secret of all this change, this wonderful accretion of the wealth of the world, is the genius of invention, controlled by scientific knowledge and wrought out by the subdivision of labor.

This means, when practically applied to our present subject: First, the conception, in one or more minds, of the elementary ideas of an invention. To embody this invention is the work, next, of the mechanical engineer, whose province it is to consider the various principles of construction that enter into the combination; to adjust the different parts to each other and the whole, having regard to the required solidity, stability, flexibility, simplicity and economy, as well as the most approved or possible methods of casting, welding, finishing and joining those parts, considerations which may not only affect the ultimate practicability of the invention, but, according to the manner in which the subject is treated, will depend largely the grace, symmetry and perfection of the machine.

The position of the mechanical engineer, in this early stage of the work, is as unique as it is important. He is like the doctor who is versed in the principles of medicine, but who, according to his appreciation of the conditions of the case, not less than the ingenuity of his resources, may often build up the patient speedily and lastingly, or only partially and imperfectly.

The physician of known ability is quite likely to be the cheapest in the end; so the timely employment of the engineer is almost certain to mean the best construction of the work proposed, in the shortest time, and with the most economy in ultimate cost.

From the hands of the engineer (who should follow up and superintend the subsequent construction) the plans and specifications go into those of the several workmen who are individually instructed, by the drawings, as to the proper way of working up their respective details. There is in this way no clashing or confusion, each man being responsible for the correct production of his part.

Such seems to be the true explanation of the economic principles of the subdivision of labor.

Men have found out *principles*, and that the most progress is made and wealth more rapidly accumulated when the several stages of any piece of work are each guided and controlled by those who have made *that part* their special study.

We have a very limited idea of the subdivision of labor when we think of it only as a number of men being divided into groups for the several manual operations in forming, say a pin. This, indeed, is subdivision of labor; but it should mean more than this. It presupposes antecedent skill and varied ability of a high order.

Before the finished product was possible, an intricate piece of machinery had to be built; which further presupposes not only skilled mechanics, but an inventive genius, and an ability, of somebody, to understand the requirements and correctly portray on paper the many parts, in detail, and as a whole. The designer was quite as necessary as the inventor or the workman.

Let it be remembered, then, that the workshop, though necessary for the practical embodiment of the invention, is yet distinct from the invention. The invention must be clearly conceived and plainly drawn on paper, clearly and in detail, carefully and studiously designed, according to the principles governing the particular construction; in short, it should be wholly created and visibly expressed in every detail, by one who is master of the subject, before it is put into the hands of a single workman.

How many ambitious, bright, but not over-sanguine men have conceived a general notion of some invention, involving mechanical principles of which, most likely, they knew little or nothing, and have thrown away time and hundreds—perhaps thousands—of dollars in blundering along—time and money that might have been saved had they started aright. Most assuredly it can be said, with emphasis, no matter how great or how small the new work proposed, construct it first on paper!

Progressive manufacturers and machinists everywhere are every year recognizing more forcibly the value of this method, and recognizing it, are growing richer. Look into our best workshops of to-day; the great foundries and machine works that turn out our exact machinery, our fine locomotives, our floating palaces; in all you will find—not "a rule of thumb" and endless experiment, but a well-constituted, thoroughly superintended drawing room. Here the work is first really constructed, on paper, the varied problems carefully throught out, the many parts fitted and proportioned to their several functions; then the various artisans and workers are given their parts, and the whole structure grows uniformly, rapidly, to perfect completion. This is the new way. It has come to stay.

It might be interesting to some to have described the actual working routine of one of our largest and most successful manufacturing establishments—the great locomotive works, whose world-wide reputation has made the American locomotive famous as a competitor on almost every line of railroad in the civilized world. One might naturally conclude that the system preferred by such a firm, after years of fruitful experience—the system which turns out two completed locomotives a day—ought to have superior merit; and if any doubt of this should remain in any one's mind, it should be fully dispersed by the further announcement that the virtues of that same system are being appreciated, and as far as possible imitated, by competitive concerns, whose capacity and business are being rapidly enlarged in consequence.

Let us, then, take a swift glance through the said establishment, beginning with the draughting room, properly the starting place for our inspection. Here, in a well-lighted, ample apartment, are a number of draughtsmen, many of them brought up in the service. These are under the supervision and direction of a superintendent, who originally decides upon the plan of each locomotive to be built, estimating its capabilities and requirements. Instructions and a specification are then given to a draughtsman in charge, who carefully constructs on paper elevations and sections necessary to the complete locomotive. The detail drawings are then executed on stiff cardboards, or other materials suited to stand shop wear, and after passing satisfactory inspection of the examiner of drawings, are given out, carefully numbered and registered, to the respective shops. No work can be done in any of the shops until this is done, thus manifesting the high importance which this successful establishment attaches to correct drawings as the starting point for all construction.

In the shops, the many details are each carefully wrought out, in strict conformity to the drawing, and, as completed, sent to the erecting shop, where, under competent foremen, the various parts are rapidly adjusted, each falling into its proper place, and in an incredibly short time the completed locomotive is breathed into by the breath of its steam life, and starts upon its career, a giant of force and monument of engineering skill.

Time was when a complete preliminary drawing was hardly known in a machine shop. Then, men blundered, and blunders are always costly. Time will be soon, when a machine shop without its drawing room, its superintending engineer, will be but a lingering reminder of an experi-

mental age before men had learned the true source of progress and wealth.

Those that still cling, like the smith of old, to the methods of a bygone age, are falling behind in the race, for while, in a sense, they may be laboriously building up a small trade, others, taking advantage of the proved better methods of success, will be forging ahead into enviable wealth.

The former has been left behind, not because of inferior ability in his line, but because he has lost time in trying himself to do what another could have better done, with less expense to him.

There is another and concluding thought that should give hope to every man in the mechanic world.

As his craft grows into closer relationship with the great world of science about and above him, it will certainly lift him to a higher plane. Men are everywhere realizing, as never before, the everlasting truth of fixed principles and universal law governing all things. If a house falls, a bridge gives way, a dam bursts its confines, it is no longer an unaccountable event. Something was deficient. The capacity to detect the cause, the power to avert the evil by a scientific knowledge of the principles of construction, is, of all knowledge, the most useful, while its possession, in proportion to its completeness, should raise its possessor to the first ranks among men.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

INVESTORS might do well to write to Mr. C. E. Hequembourg, President of the Bradford Gas Light and Heating Compauy, Dunkirk, N. Y., respecting the advertisement inserted by his order in this issue of JOURNAL. Under it he offers for sale a complete water gas plant having a capacity for the daily production of 60,000 cubic feet of gas.

SUPT. GEO. W. HUNT, of the West Troy (N. Y.) Electric Light Company, gives the report that that plant is to be sold to the Municipal Gas Company, of Albany. To which we might add that the proprietors of the latter are in no wise anxious to succeed to the ownership of the former.

WE understand that the five gas wells yielding natural gas in the district of Stockton, Cal., cost a total of $26,600, which seems to be a rather big investment when viewed in the light of the output secured, the latter being put at less than 250,000 cubic feet per diem.

IN our last first mention was made of the report submitted by the special committee of the Boston, Mass., Common Council, appointed to determine whether the method of manufacturing gas pursued by the Boston Gas Company at its Prince street station was injurious to the health and comfort of the citizens of the vicinity. In completion of that mention we herewith submit the report in full, together with the action subsequently taken thereon by the Council: "Your committee respectfully report that they have completed their investigation and listened to considerable testimony upon the subject from the residents in the district, and are convinced that a great deal of annoyance and discomfort is caused by the method employed in the manufacture of gas. The evils complained of are chiefly the dust, noise and smoke which result from and are occasioned by the different processes carried on in the manufacture, and your committee are of the opinion that some steps should be taken, if possible, to relieve the citizens of the North End living in the vicinity from the annoyance to which they are subjected; and they accordingly respectfully recommend the passage of the following order: *Ordered*, That the Board of Health be requested to investigate the methods employed in the manufacture of gas at the gas works on Prince street to ascertain whether some relief cannot be secured to the residents in the vicinity from the annoyance and discomfort resulting therefrom." The report was accepted and the order was passed. We supposed originally that the special committee had decided to base its report upon the ground that the residents of the North End were being "discomforted" because of the purifying arrangements in vogue at the Prince street station, for that is the great peg whereon Councilmanic smelling committees usually hang their objections after a visit to a gas works. The real presentment, however, is so absurd as to hardly call for second thought, much less to call for the intervention of the Board of Health. If "dust, noise and smoke" are to be bars to the operation of manufacturing establishments in Boston, we imagine that many enterprises in that city will have to be "investigated" by the local Board of Health.

A CORRESPONDENT sends the following regarding the recent movement at Laconia, N. H., for the organization of a new lighting company: "I have read your items about the formation at Laconia of the Winnipiseogee Gas and Electric Light Company, and from the tenor of the same I judge you to be under the impression that the organizers intended to operate a company in some New Hampshire town at present not supplied with electricity or gas. With that understanding, I herewith send you some particulars concerning the intention of the company's promoters. An adjourned meeting of the Directors of the Winnipiseogee Gas and Electric Light Company was held at the office of Messrs J. W. Busiel & Co., Laconia, on the first inst., when the matter of a permanent organization was taken up. The election for officers resulted in the following choice: President, John S. Crane; Vice-President, S. B. Smith; Clerk, Frank Edgerly; Treasurer, M. L. Meleher. A committee of three was then named—Messrs. Jno. S. Crane, H. W. Burgett and G. Busiel—to confer with the Directors of the old Laconia Electric Light Company, with a view to purchasing the plant and franchises of the latter corporation. The meeting thereupon adjourned. On the day following the committee devoted themselves to the purpose outlined, and while no definite conclusions were reached, it may be said that the preliminary negotiations were all in favor of the new Company's proposition. So much for the actual state of the case as it stands at the time of writing—November 7. While this has on its surface all the elements of a seeming opposition company, the circumstances, in my opinion, justify such a proceeding. To put it briefly, two companies cannot occupy the field here with profit to both, and there is no denying the fact that a great deal of dissatisfaction has been manifested toward the management of the old Company and its method of doing business. Its service has not been of the best for some time back, and the most woeful delinquency is chargeable to the account of the street lighting (arc system) contract. In fact, the defective supply was so pronounced that a considerable sum in fines, or rebates, has been taken by the town from the quarterly bills submitted. Even admitting that the old Company was the first to furnish electric lighting in Laconia, and while much charity has been vouchsafed it, on that account, for its miserable performance under its charter, the point has been reached where justice to the town's interests must override the gentler virtue. Of course, whether the proposed change will better the position or not remains to be seen; but it is measurably certain that an improvement will result. Further, whether a consolidation or substitution is effected—and I think the latter will be the result of the present movement—it is beyond doubt that the old Laconia Company's plant cannot remain in its present situation, and yield any sort of acceptable service; simply because of inadequacy of space, power and plant. Of course all this is highly entertaining to the proprietors of the Laconia Gas Company, who have been adding largely to their plant—an addition of about 50 per cent. to the Company's holder capacity is now about completed—and their business progresses in a way that must give them great satisfaction. In the final outcome of the transactions I would not, in fact, be greatly surprised were the Gas Company successful in absorbing the entire right to supply gas and electric light in Laconia. Its proprietors certainly could be depended on to handle the business with satisfaction to the people.—R. S."

ARTICLES incorporating the Germania Gas Light Company, of San Francisco, have been filed by Messrs. J. Wiesender, I. G. Saftig, I. F. Holling, J. Zeller and P. Larimee, who assert that out of the $100,000 of capital, the sum of $63,500 has been actually subscribed.

THE Board of Selectmen of Randolph, Mass, have granted the proprietors of the Randolph and Holbrook Light and Power Company the right to operate gas and electric light plants and an electric railroad in the villages named.

A WASHINGTON (D. C.) authority says that the appropriation bill for the year 1889-90 contained a provision that the "Commissioners shall investigate and report to Congress what deduction can be made for gas and electric lighting, both for annual and 5-year contracts," and authorizes them to invite proposals for supplying light at reduced rates. To enable the Commissioners to comply with this provision, Major Raymond recently submitted a report with reference to the matter. With respect to gas lighting Major Raymond decides that the price now paid ($20 per lamp per year) ought not to be reduced for a 1-year contract, but that a reduction of from 25 to 50 cents per lamp may be made should a 5-year contract be authorized. He says that the municipal service of the Washington Gas Light Company has been greatly improved during the last two years, and is now the best in the United States, so far as concerns the quality and illuminating power of the light. The cost of the public electric lights has been determined from statistics of electric lighting gleaned from many districts throughout the country, supplemented by deductions presented by Major Raymond on his own account. The cost as determined by the figures from other cities is returned at 57.6 cents per light per night—2,000 candle power arcs, on all-night schedule—while the Major's deductions put the cost per night at 58.9 cents per light. From these figures Major Raymond concludes that 60

cents per arc per night is not excessive for an underground system of distribution. In concluding his report, Major Raymond says: "Throughout this investigation I have assumed that the Government is to pay a fair price for its electric light service, like any private consumer. It is to be remembered, however, that the electric lighting company enjoys valuable privileges, occupying the public streets with its conduits and monopolizing the profitable business of private electric lighting in the cities of Washington and Georgetown, and for these privileges it makes no payment. I know of but one way to determine the value of such privileges, and that is by competition. If the District Government were authorized to contract for the public lighting with one or more responsible companies, after due advertisement, the successful bidders to have the privilege of private lighting, I have no doubt the expense of the municipal service could be greatly reduced."

THE Amherst (Mass.) Selectmen have received a proposition from the Amherst Gas and Electric Light Company to furnish free to the town five street lamps (50-candle power each) of the incandescent electric type instead of the single arc lamp (2,000-candle power) which the town was to obtain under the terms of the Company's franchise. The proposition is likely to be accepted.

THE Boston and Albany Railroad has discontinued the practice of lighting two of its fast service passenger trains by means of electricity furnished from storage batteries or accumulators. The reasons given are: The great weight of the apparatus required; the great expense of keeping up the system; the unreliability and low illuminating value of service obtained.

UNABLE to cause the city authorities by ordinary methods to keep its laborers from unduly damaging the conduits of the Salt Lake City Gas Company—the work of reconstructing the city's sewers is underway—the latter has instituted suit against the authorities for damages in the sum of $35,000. An injunction to prevent further interference of a similar character has also been applied for.

THE City Council of Newport, R. I., has voted to make the following contracts for the public lighting: The Newport Illuminating Company, 75 arcs—Thomson-Houston system, 2,000-candle power each, all-night schedule—at 50 cents per light per night, to run three years; Newport Gas Light Company, gas supplied to public lamps and buildings to be charged for at the rate of $1.50 per 1,000 cubic feet. An ordinance was also adopted which places the erection and maintenance of all electric light current carrying wires under the charge of the Chief Engineer of the Fire Department. The bid submitted by the Edison Company was identical with that submitted by the Thomson-Houston folks.

THE increased rates for the domestic supply of natural gas in certain districts controlled by the Philadelphia Gas Company have caused much indignation amongst the residents affected by the figures. For instance, it is said that mixers have been removed from 2,500 stoves in Jamestown, N. Y., and that 3,000 burners have been shut off at Erie, Pa.

WE understand that a son of Mr. Forstall has been promoted to the position made vacant by the decease of the late Alfred Arndt.

THE Louisville (Ky.) Gas Company's system of distribution has been subjected to a thorough overhauling this summer, and several miles of new mains have been put down. By the way, the casual visitor to this beautiful southern city cannot fail to be impressed with its surprisingly rapid development in growth and population. There is no boom about the advance, either; it is steady, substantial and pronounced.

A FURTHER hint in connection with the Louisville Gas Company is given in the promotion of Engineer Barret to the Vice-Presidency, which result was reached at the late annual election. We congratulate Mr. Barret and the Company.

ONE of the essentially stable business enterprises of Washington Court House, Ohio, is its Gas Company, which stability is not to be wondered at when one remembers that those interested in its management are the most progressive men in that thriving community. The Company was organized in 1875 with a capital stock of $50,000, and the works were originally arranged for the manufacture of oil gas. This plan, however, was soon abandoned, the plant being altered to the requirements of the coal process, which is still found to be profitable and satisfactory. The candle power of the gas sent out averages 19.50, and 300 consumers are on the Company's rolls. Of these about 110 use gas for purposes other than for illumination. The rates in effect are: Illuminating gas, $2 per 1,000; for heating and cooking, $1.50—those who use gas for lighting, heating and cooking obtain their entire supply at the latter figure; for manufacturing purposes, $1.25. Every printing house in the city—four in number, uses gas power, while the large planing mill of H. D. Pursell is also operated by a gas engine, and the city also maintains one of these motors in its public building. That is a pretty good showing, and emphasizes what energy can accomplish; and while others of the fraternity are figuring out what their percentage of day output to total sendout is, they might do well to bear in mind that the Washington Court House Company distributes 35 per cent. of its make for purposes other than illumination. No charge is made for putting in services from main to meter, and what the Company has to sell is freely advertised. The officers of the Company are: President, Morris Sharp; Secretary and Treasurer, Jerome Penn; Directors, Morris Sharp, Hon. Daniel McLean, Col. H. B. Maynard, F. L. Nitterhouse and Jerome Penn. The latter gentleman is what is known "out that way" as a "hustler."

AT a recent meeting of the Gas Committee of Councils (Philadelphia, Pa.), the sub-committee having under consideration the subject of the Toraya improved wood gas process submitted a report, in which, after explaining the process and the result of an inspection of the same, they recommended that the process be introduced in one of the stations of the city gas works for the purpose of fully demonstrating the advisability of its adoption. The committee also submitted an ordinance authorizing the Director of Public Works to permit the Company to introduce its methods at one of the city works, and to extend all facilities to enable the Company to demonstrate the value of the process, provided there be no cost to the city in fitting up and adapting the works. The ordinance also authorizes the Director, if there be shown any benefits from the manufacture of gas by this method, to accept from the Company a sufficient quantity of gas so manufactured, and distribute the same so as to enable him to make an exhaustive report as to whether it will be to the interest of the city to enter into a contract with the Company; provided that the cost of the gas does not exceed 45 cents per 1,000 cubic feet. After some discussion the report and ordinance were sent back to the sub-committee, with instructions to confer with Director Wagner as to the time and place where the experiment can be made.

THE proprietors of the Citizens Gas Light Company, of Bloomington, Ills., have decided to put in an electric light plant. The estimated cost of the installation is put at $50,000.

THE Citizens Gas Company, of Bloomington, Ills., has reduced the selling rate to $1.75 per 1,000 cubic feet. This is a reduction of 25 cents per 1,000.

WE regret to report the death, at his home in Baltimore, on the 7th inst., of Wm. Johnson, formerly Superintendent of the Elkton (Md.) gas works.

THE State Gas Commissioners will to-day take testimony on the appeal of the Chelsea (Mass.) Gas Company from the action of the Board of Aldermen of that city in granting a franchise to the American Fuel Company.

THE proprietors of the Stonington (Conn.) Gas Company have determined to abandon the dangerous and wasteful plan formerly followed of keeping their oil enriching supplies in barrels. A sunken iron reservoir capable of holding 5,000 gallons of oil is underway, and this provision will enable the Company to receive its supply from the contractors by means of tank cars.

SOME time since we noted that Embley Brothers, of Utica, N. Y., had instituted suit against the local Gas Company for damages said to have been caused them on account of the removal of a gas meter that measured the gas supplied on their premises. The case was tried before Special City Judge John F. Gaffney, who on the 8th inst. rendered a decision in favor of complainants, awarding them damages in $170. A correspondent forwards us the following respecting the case: "The firm of Embley Brothers entered into business at No. 159 Genesee street, Dec. 6, 1888, and made application for a gas meter to the Equitable Gas and Electric Light Company, and at the same time introduced electric light in their store—both sorts of illumination being furnished by the Gas Company. The firm continued this use until February last, when the Embleys authorized the Utica Electric Light Company to supply them with light. On July 2 the Gas Company removed the gas meter from the store, and on August 1 the Embleys, through their attorneys, Matteson and Harvey, served notice upon the Gas Company for a re-

turn of the meter. The Company refused to replace the instrument unless the firm made formal application for same and agreed to pay for resetting. The applicants refused on the ground that these charges had been paid by them before. On last Monday (4th inst.) the case came before Special City Judge Gaffney, Matteson & Harvey appearing for the plaintiffs, and W. & N. E. Kernan for the Gas Company. From the evidence it appeared that Embley Brothers simply used gas in the cellar of their establishment and at one desk in the rear of the store, the balance of the premises being lighted by incandescent electric lamps. While the monthly gas bills were very small—a few cents in some instances—these were promptly paid, but the Gas Company finally ordered the meter to be removed on the ground that the Embleys had ceased to be consumers—I should have also said that in one month (June) no gas was used by the complainants. The Company proved their testimony as to quantities of gas used by the bills paid by plaintiffs. The latter simply testified that they had always used gas in their cellar and at the rear of their store. On the 8th, Judge Gaffney handed down quite a lengthy opinion, in which he ordered judgment for the plaintiffs in the sum of $170, and found that it was incumbent upon the defendant to replace the gas meter and connections, and to supply gas to the parties while they continued to pay for the same. The case will undoubtedly be appealed."

A Pleasing Sequel to the Baltimore Meeting.—A very pleasing sequel to the recent meeting of the American Association, at Baltimore, was the remembrance of Mrs. Chas. H. Dickey by the ladies who accompanied the members to that city. Owing to illness, Mrs. Dickey was unable to take the part in the reception and entertainment of the fair visitors that had been planned and hoped for by her. But so constant and painstaking were the efforts of her husband in fulfilling his very agreeable duties as Committeeman in special charge of the entertainment of the ladies, that his pleased charges made up a tidy purse among themselves to purchase a souvenir to be presented to Mrs. Dickey in remembrance of their enjoyment of the many good things provided for them by the ubiquitous Charles. The ladies decided that a bracelet would be the proper thing, and duly commissioned Capt. White to make the investment. The Capt. promptly associated Mrs. Capt. on the committee, and her taste is evident in the very neat and pretty bracelet which has found its way to the arm of Mrs. Dickey. Both Mr. and Mrs. Dickey were much surprised by this very kindly act of the gas sisters, and have united in a very pleasantly worded letter of thanks which the Captain is thinking of making the basis of an extended series of calls upon the forty or fifty fair contributors. The Captain is an experienced traveler, and the ladies may see him and the letter yet.

The Newport (R. I.) Gas Light Company is installing a water gas apparatus (in the shape of an auxiliary plant) calculated to produce 100,000 cubic feet in 24 hours.

"The old Council Bluffs (Iowa) Gas Company has secured control of the Council Bluffs Electric Light and Power Company, and the former is now in charge of both plants. The tower and pole systems of arc lighting are operated, and I may say that the proprietors do not seem to be greatly impressed with the incandescent division of their electric business, either as to availability or profit. In any event they propose to keep its development at the minimum. Hitherto the Company has manufactured nothing but coal gas, but plans are now being drawn for the alteration and enlargement of the works, with the intention of adapting the same to the generation of water gas. Good gas coal costs $9.50 per ton here, and the ruling gas rate is $2.25. Gas stoves for cooking and heating, and the use of gas for power makes good headway here, and it is about settled that when the Company's new plant has been completed the gas rate will be put at $2 per 1,000. Our friends in the East can rest assured that the Council Bluffs Gas Comapny means to keep up with the bandmaster.—E. P. C."

At a recent session of the Louisville (Ky.) City Council the office of Electric Light Inspector was created, and a resolution was passed recommending the Legislature to amend the charter of the Louisville Gas Company so as to permit the latter to supply electric currents for light, and power.

In the case of Soloman Bergman against the St. Paul (Minn.) Gas Company, in which plaintiff asked for damages, on the ground that the operation of the gas works depreciated the value of tenement property owned by him, the jury returned a verdict for defendant. The findings were as follows: "That no greater volume of smoke and offensive odors issued from the gas works since the enlargement of the same than was the case before; that the gaseous odors and smoke have not injured the selling or rental value of the property; that the rental value has been decreased by general depreciation of the rental values throughout the city; and that the business was conducted as carefully and prudently as an ordinary person would conduct his business." A stay of 20 days was allowed to complete the transcript of evidence and perfect an appeal to the Supreme Court.

At a meeting of the Columbus (Ind.) Council the question under discussion was the public lighting contract. The proposition submitted by the Citizens Electric Light Company (controlled by the local Gas Company) was as follows: To furnish the required number of 2,000-candle power arcs, on a moontable, lights to burn from dark until midnight, for $52.12½ per arc per annum, or on a rate of $72.33½ each if all-night lighting was determined on. The special committee appointed some months ago to inquire into the feasibility of the city owning and operating its own plant presented its report, which recommended the adoption of the following: That the Waterhouse system offered by the Westinghouse Company be installed, under the proposition to construct a plant equal to the supply of 60 half-arcs and 24 incandescent (20-candle power) lamps, the latter to be used for lighting the city offices and the water works; the plant to be located in the water works pumping station, and the motor power to be furnished by the city. For this the city is to pay an annual rental of $1,714.16, the payments to cover a period of six years, at the end of which period the plant is to become the absolute property of the city. The expense of operation is to be borne by the city. The report of the committee was accepted, and the contract was ordered signed. Summed up in a few words, Columbus has agreed to pay the Westinghouse Company something over $10,000 for a portion of the apparatus necessary to maintain a 65-light (half-arc) plant. In completion of the farce, it should be added that the city is to pay all expenses of making the necessary changes at the water works station.

The new management of the Hastings (Neb.) Gas Light Company is as follows: President, L. Patterson; Secretary, Jno. Van Liew; Supt., H. A. Patterson.

The Committee on Gas, Oil and Electric Lights of the Chicago City Council has reported favorably on the resolution referred to it last September which provides for a committee of five to act with the Mayor in making the necessary inquiry and investigation to determine if it is desirable or feasible for the city to manufacture and furnish gas for lighting and heating to the city and to private consumers. The report was adopted.

Under the new agreement between the Gas Trust and the authorities of Chicago, the former will light all the public gas lamps at the rate of $20 per annum each, whether the same be located in the city proper or in the suburbs. The gas lamps maintained amount in round numbers to 24,000, and as the rate formerly charged for each lamp amounted to an average of $25.25 per annum it will be seen that the new schedule means a large money saving to the city.

Correspondence

[The Journal is not responsible for the opinions expressed by correspondents.]

A Correction by Mr. E. C. Jones.

Boston Gas Light Company, Office of the Works,
North End Station, 609 Commercial St.,
Boston, Mass., Nov. 9, 1889.

To the Editor American Gas Light Journal:

In your report of the discussion of my paper on "Leakage and Condensation," recently read before the American Gas Light Association, the line, "From each square centimeter of the earth's surface there issues every year 44.4 degrees of heat," should read, "From each square centimeter of a horizontal section of the earth's surface there issues every year 41.4 gramme degrees of heat."

Will you kindly publish this correction in your next issue and oblige,

Yours, truly, E. C. Jones.

And another from Mr. Norris.

United Gas Improvement Company,
Jersey City, N. J., Nov. 11, 1889.

To the Editor American Gas Light Journal:

In the discussion on Prof. Love's paper, at the Baltimore meeting of the American Gas Light Association, I made a mis-statement as to the relative amounts of air required for the combustion of hydrogen and carbonic oxide. This I almost immediately corrected. The reports of the proceedings contain my mis-statement, but the stenographer seems to have omitted its withdrawal. This is annoying, and I shall be pleased if you will give this space in your columns. Yours, truly,

Rollin Norris.

THE AMERICAN GAS LIGHT JOURNAL

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AGENTS.

NEW YORK.—AMERICAN NEWS CO., 39 and 41 Chambers Street.
PHILADELPHIA.—PRATT & CO., Corner Ninth and Arch Streets.
Germany.—B. WESTERMANN & CO., of New York.

MONDAY, NOVEMBER 18, 1889.

The Market for Gas Securities.

Consolidated during the week sold up to 94 (at which it is bid for to-day, Friday), with a probability that still higher figures will be made. The earnings of the Company show a most satisfactory increase. Equitable is in good demand at higher figures, and Mutual also shows a satisfactory advance. Brooklyn shares are fairly firm. During the week 40 shares of Standard (common) brought 50 at auction. Chicago Trust has declared a quarterly dividend of one per cent., but the shares are dull to weak at 53¾ to 54. The meeting of the shareholders to determine the proposed sale of the St. Louis Company to the Laclede Company was all in favor of the proposition. This puts the Laclede in possession of about 11,800 shares out of the 12,000 shares in the old St. Louis Company. Local brokers quote new common stock in the Laclede at 20¼ to 21. The city wants $400 per share for its holdings (200 shares) in the St. Louis Company, but will probably agree to take $375—an amply large price. The Malden and Melrose (Mass.) Company has declared its quarterly dividend of 2 per cent.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,
16 WALL ST., NEW YORK CITY.
NOVEMBER 18.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	94	—
Central	500,000	50	—	—
" Scrip	220,000	—	—	—
Equitable	4,000,000	100	122	127
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	116	118
Mutual	3,500,000	100	103	105
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	60	70
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	107	110x
Citizens	1,200,000	20	65	70
" S. F. Bonds	320,000	1000	100	103
Fulton Municipal	3,000,000	100	124	125
" Bonds	300,000		100	105
Peoples	1,000,000	10	74	75
" Bonds (5's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	90	—
Nassau	1,000,000	25	112	—
" Ctfs	700,000	1000	100	—
Williamsburgh	1,000,000	50	118	122
" Bonds	1,000,000	—	108	112
Out of Town Gas Companies.				
Boston (Mass.) Gas Co	2,500,000	500	240	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
" " Bonds	45,000	—	—	—
Chicago Gas Trust	25,000,000	100	53¾	54
Cincinnati G. & C. Co.	6,000,000	100	214	218
Consumers Toronto	1,000,000	50	190	200
Central, S. F., Cal.			80	90
Capital, Sacramento, Cal.			58	
Consolidated, Balt.	11,000,000	100	42¼	42½
" Bonds	6,400,000		107	107½
Hartford, Conn	750,000	25	102	108
Jersey City	750,000	20	190	—
Laclede, St. Louis, Mo.	2,000,000	100	140	—
Louisville, Ky.	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	48	51
" Bonds	240,000	100	103	—
New Haven, Conn		25	200	—
Oakland, Cal.			35	35½
Peoples, Jersey City		—	60	61
" " Bonds			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	99	100
Syracuse, N. Y.	500,000	25	—	—
St. Louis, Missouri	600,000	50	—	750
San Francisco Gas Co.			60	60½
San Francisco, Cal.	10,000,000	100	59¾	60
Washington, D. C.	2,000,000	20	200	208
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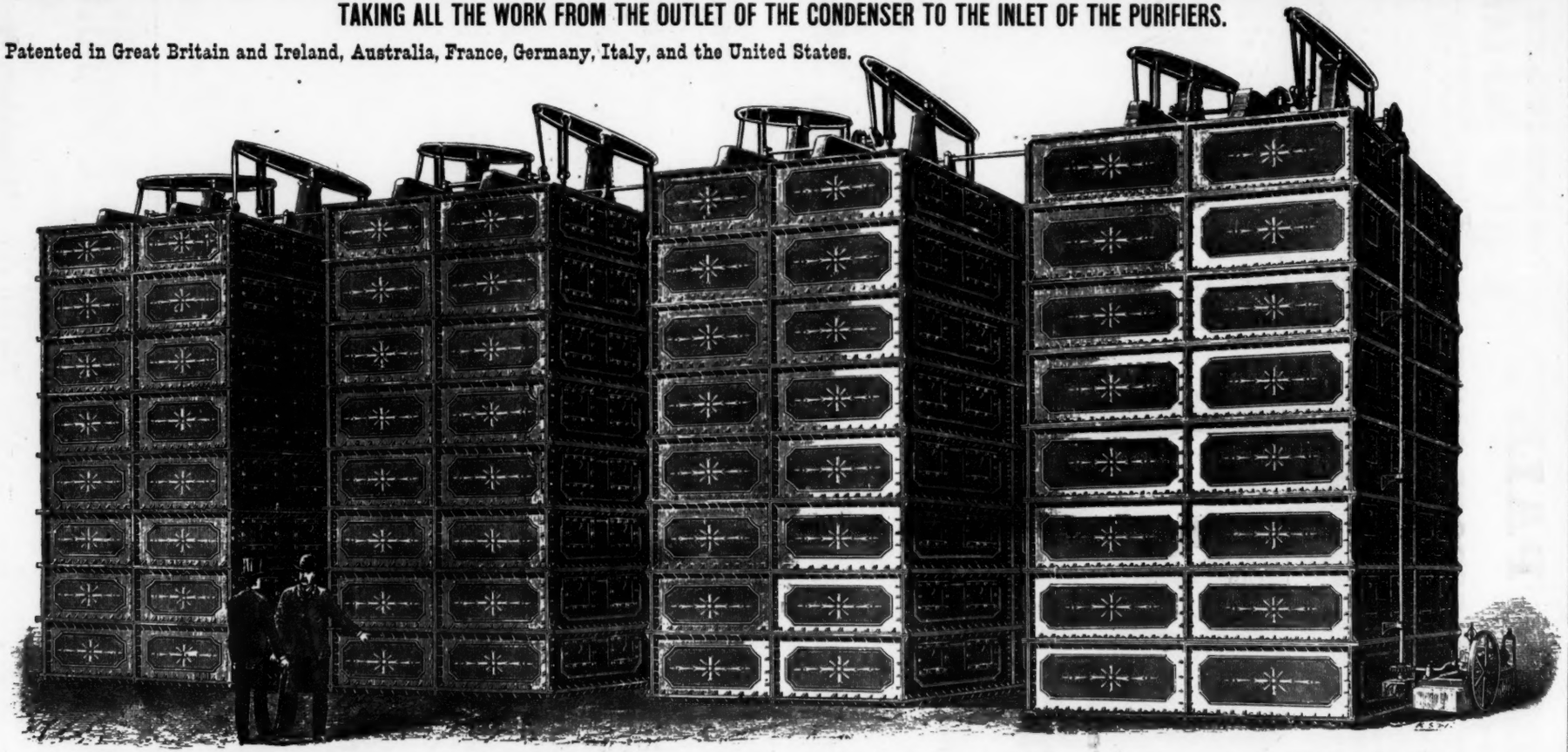

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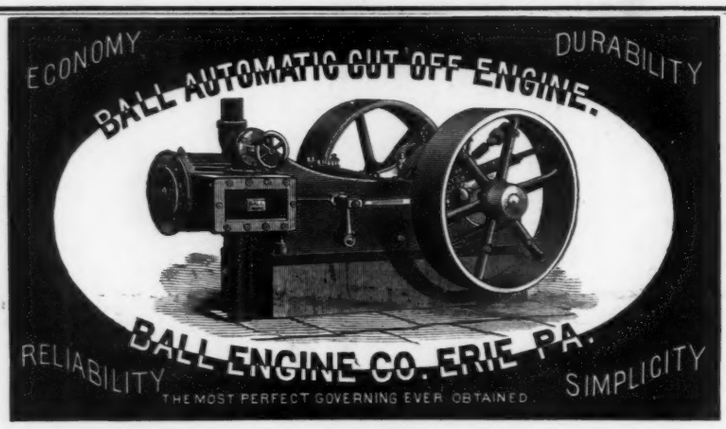

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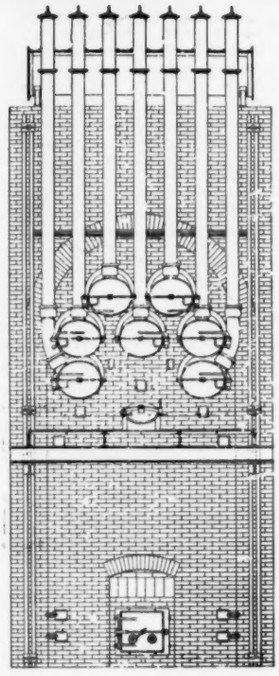

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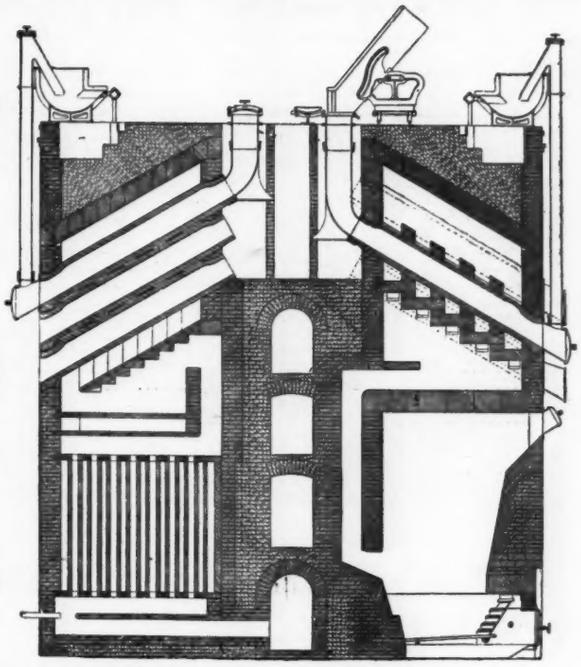

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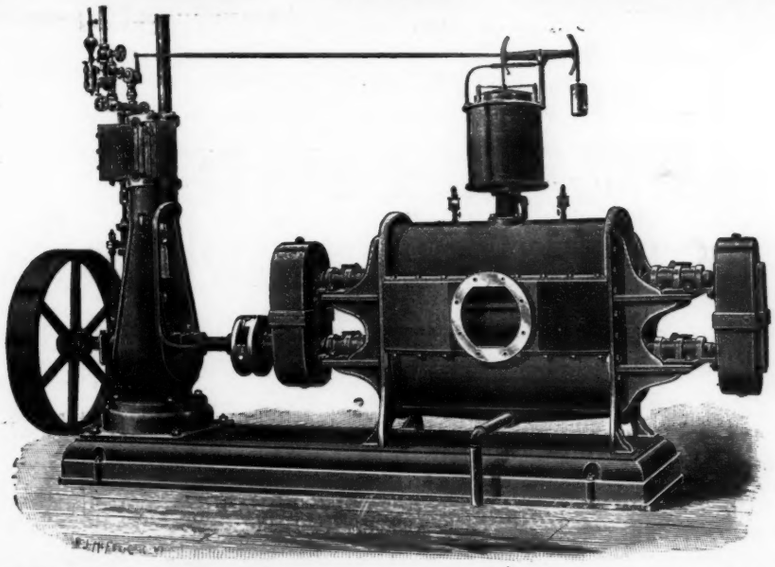

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"	1,250,000
"	1,250,000
"	1,000,000
"	1,000,000
"	3,000,000
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"	1,000,000
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"	750,000
"	1,250,000
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Fenton	400,000
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"	1,250,000
"	1,250,000
"	1,250,000
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"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

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Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	500,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A	1,000,000
Louisville "	1,500,000
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"	1,500,000
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"	1,500,000
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"	1,750,000
"	1,750,000
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"	1,000,000
"	2,500,000
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"	2,000,000
"	1,000,000
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Silesian Coal Co.	600,000
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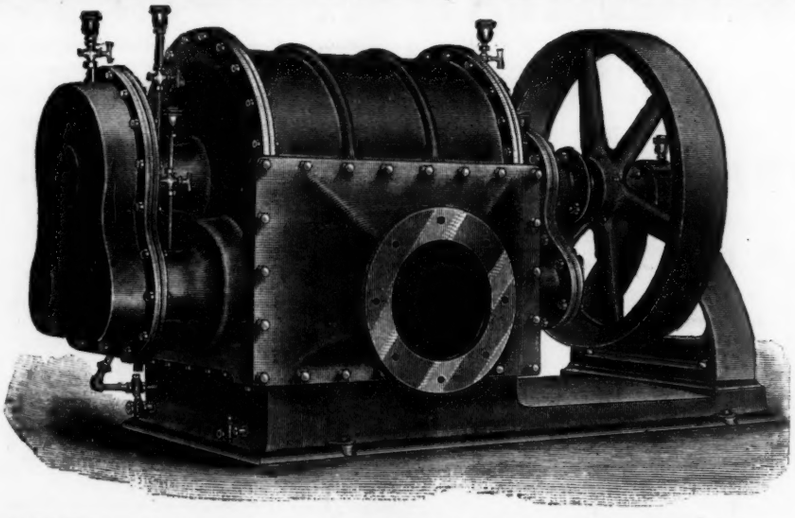

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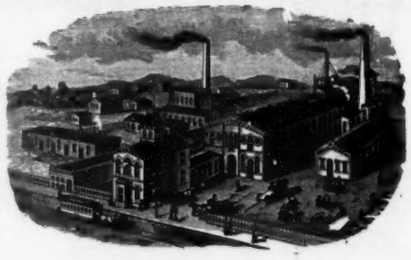

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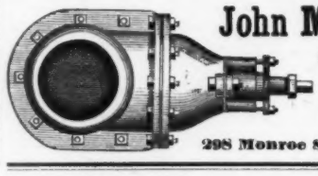

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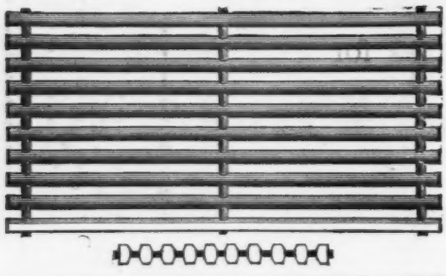

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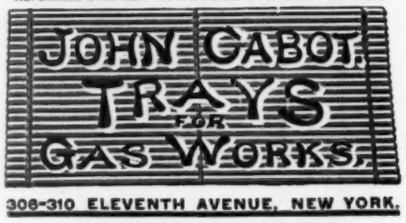

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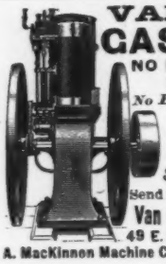

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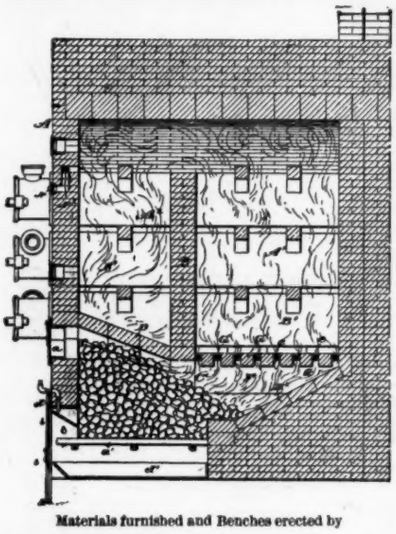

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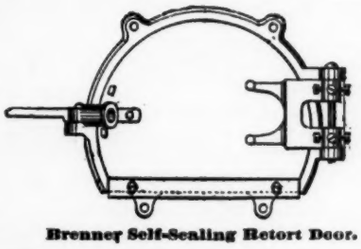

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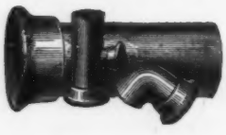

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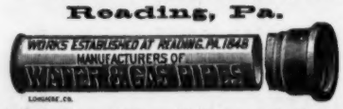

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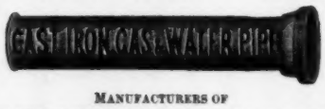

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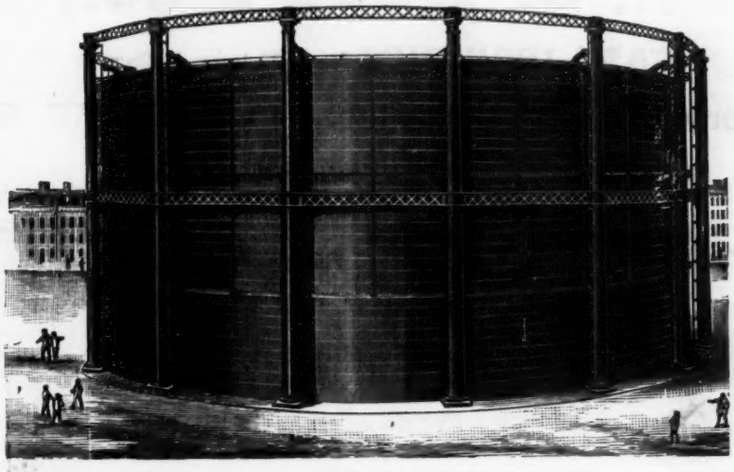

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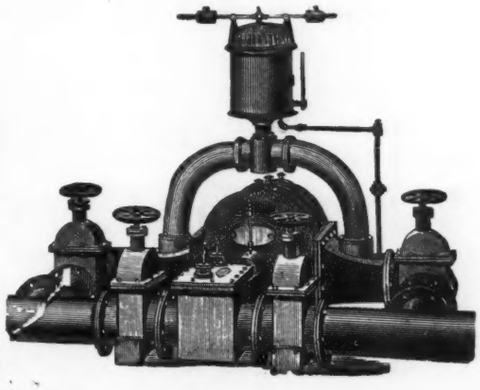
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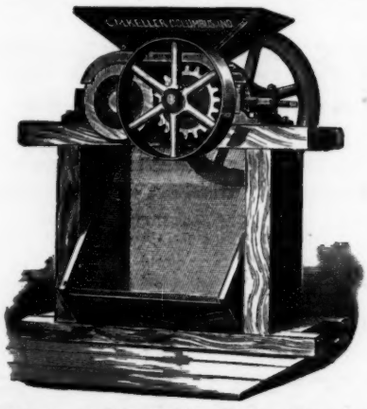

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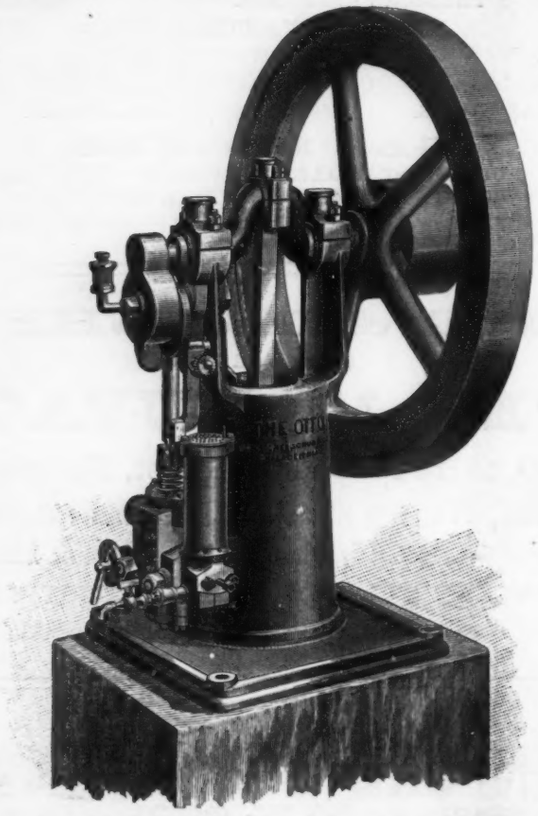

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